IRREGULARITIES

OF

THE TEETH.

TALBOT.

IRREGULARITIES OF THE TEETH

AND

THEIR TREATMENT.

BY

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TO THE

MEMORY OF MY BROTHER,

THE LATE DR. CHARLES F. TALBOT,

THIS VOLUME

IS AFFECTIONATELY DEDICATED.

PREFACE.

In the preparation of the second edition of his work the author has aimed to add such matter as may make it more complete without altering the general plan. Some of the chapters contained in this edition appeared in the *Dental Cosmos* of 1888–89. A historical sketch of theories has been prepared which it is hoped will interest the student, inasmuch as it gives him a fair knowledge of the rise and progress of theories regarding the causes of irregularities, from which it will be seen that many theories supposed by the majority of practitioners to be of comparatively recent date are among the first advanced.

The author has taken particular pains to make the treatment of etiology complete, and the distinctions of the causes of irregularities clear. This subject having been treated hitherto only in a general way, the author hopes that others will be encouraged in further researches in this interesting field, where there is ample opportunity for labor and observation. In the classification of irregularities the aim is to give the student a standard of comparison which, when fully understood, will aid him in placing the irregularity under consideration in its proper class, every typical form being illustrated.

In the correction of irregularities no fixed rules can be laid down for treatment as in surgery, because the resistance offered by each case is a force known only approximately beforehand.

Only the general law can be laid down for correction, this law being subject to modification by experiment. For this reason the author has described the mechanical laws, illustrated their application in the simplest manner possible, and has given practical cases where they have been found efficient. He believes this method to be the best to impress the principal features of the operative treatment of irregularities upon the mind of the student. The author has omitted many appliances in use, not because he believes them less efficient than some of those given, but because, in his opinion, they add nothing to the illustration of the principle.

The author desires to acknowledge his indebtedness to Dr. E. Mergler Schell for assistance; to Dr. Marie White for the compilation of the historical sketch; to Dr. H. J. McKellops for the use of his valuable library; and also to the S. S. White Dental Manufacturing Company for the use of many wood-cuts.

EUGENE S. TALBOT.

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INTRODUCTION.

In presenting his views regarding the etiology of irregularities of the teeth and their correction, the author lays particular stress on underlying principles. It is believed that a full comprehension of these is necessary to success. A study of isolated cases is valuable for the training of the observation, and for deciding what appliances shall be used, but it is impossible to get at the relations of cause and effect, and make a correct diagnosis without a knowledge of principles. The operator, without this knowledge, must be more or less empirical in his treatment. The laws that govern the body as a whole must be understood, for each organ is governed by them more or less. Suffering of one part implies suffering of the whole. In order to make clear these principles, a large number of cases are cited. These are not hypothetical cases, but are such as have occurred, from time to time, in the author's practice.

Health of the body, like that of the mind, depends largely on the proper performance of the various bodily functions. The kind and degree of functional activity must be suited to the individual. When this accord exists we have happiness of mind and health of body. In a recent article in a medical journal, the baleful influence of idleness in prison life is discussed. It is stated that the consequences of the labor law of 1888 were the increase of insanity, a higher death rate, a shattered *morale* and an unprecedented deficit in the sum total of earnings as compared with expenditures. This illustrates a far-reaching principle. Not only is activity necessary to the well-being of the individual as a whole, but to every organ.

Excessive action or impaired function imply disease. The stomach, if overloaded or required to digest unsuitable food, becomes enfeebled. Every organ depends for its integrity immediately on the nervous system. When nervous activity is impaired, or lacks balance, the general balance of function is disturbed. Nowhere are results of this lack of equilibrium more visible than in the teeth.

Malnutrition resulting from disease, from insufficient or unsuitable food and unhealthy environment, is the cause of idiocy, insanity, blindness and other defects. Derangement of the nervous system usually underlies these conditions as found among the poor. But there is another class of individuals who suffer from neurotic conditions. They are those who are well fed and housed, but have overtaxed their nervous systems by improper modes of life and various forms of excitement. The two classes have this in common, that the functions of the nervous system are impaired, and they show similar results of defective nutrition. This want of balance produces an osseous system that shows excessive development in some of its parts, and arrested development in others. Nowhere is this more manifest than in the maxillæ. Thus we have the causes of constitutional irregularities established. We see the disturbances of the functions of the organs of the body as a whole result in *constitutional* irregularities. The impairment of the function of the teeth themselves gives rise to *local* irregularities. The importance of the correct performance of the function of these organs will be seen from a brief consideration of the results of impaired activity.

1. Teeth to be clean must be used. When one half of the arch alone is in use, the other half shows an unusual deposit of tartar, with hypertrophy of the mucous membrane and gums.

2. The development of the alveolar process depends on the use or disuse of the teeth. When the bite is too close in the posterior portion of the arches, an effort is often made by Nature to correct this by lengthening the process in the anterior part. Cases of anterior protrusion afford study of these conditions. When forced to

perform an abnormal function in these cases excessive development results.

3. Not only does the alveolar process lengthen when not in use, but individual teeth elongate as well when deprived of their antagonists.

4. Nowhere does interrupted function produce more mischief than in the derangement of articulation. The function of every individual tooth is indicated by its form. This shows that it should touch at certain points and antagonize at others. There is a certain degree of motion perceptible only by its effects. When the support of a tooth is withdrawn by the extraction of its neighbor, this motion is no longer sufficiently restricted, and there is more or less migration or tipping. The basilar ridges of the anterior teeth, and the cusps of the posterior, are resting-places for their antagonists. Let this support be taken from one or more teeth, and their function is destroyed in part and their health impaired.

The portion of the book devoted to treatment is carried out on the same plan as the first part, *i. e.*, general principles are laid down rather than a great many details. The mechanical principles upon which the regulating appliances are based are described, so that the power and limitations of each are understood. The hap-hazard method of employing the same means for the correction of what appears to be the same case is discouraged, inasmuch as the resistance offered is an unknown quantity in every case, and cannot be accurately determined beforehand. Great intelligence and an exact knowledge of every mechanism is, therefore, of importance. Simplicity of construction is advocated for obvious reasons, as some simple appliances, easily manipulated, may serve for a number of different purposes when their range of usefulness is understood.

The author has endeavored to aid the student in becoming a close and accurate observer, and to form correct conclusions, close observations and correct methods of thought being the means of scientific

progress. When these habits are once established every denture that comes under the practitioner's notice will afford points of interest; he will not only see the tooth upon which he may be operating, but will notice points in the articulation which will furnish him with excellent material for study.

It is a deplorable fact that what is called scientific research is frequently of no value whatever, but is recorded and read by a large and credulous portion of the profession. Generalizations based on the observations of a few cases are taken for general laws, and so recorded. The mere accompaniment of a phenomenon is taken for a cause; the opinion of a layman, who cannot possibly have a knowledge of the case, is recorded as a fact. These assertions are easily verified. However successful we have been in this country, we have much to learn from our European brethren in this respect,—a number of years' careful preparation for work, and the collection of sufficient data before these are embodied in print. This will come in time. We shall learn that four years of study are more likely to produce satisfactory results than two,—that time is a necessary element of success. This will do away with hasty conclusions and methods of reasoning that do not deserve the name. When we have attained comprehension of the utility of thoroughness there will be a greater respect for knowledge among ourselves, and with this will come the respect of the public for our profession; for however easily the public appears to be duped, it is keen-eyed in the long run and gives honor to whom honor is due. With the strides of progress that we are making in many respects, and our material gains, come new requirements. The dentist of fifty years ago, who honestly did his work as best he knew, and by virtue of conscientious efforts produced results that have stood the test of years, does not meet the requirements of to-day. There is now a demand for more breadth of scientific culture, and more of that comprehensive knowledge without which good judgment is impossible.

IRREGULARITIES

OF

THE TEETH.

PART I.

CHAPTER I.

HISTORICAL SKETCH OF THEORIES REGARDING THE ETIOLOGY OF IRREGULARITIES OF THE MAXILLÆ AND TEETH.

SUPERNUMERARY TEETH.

HIPPOCRATES, who lived about 500 B.C., was the first to study human teeth, and laid down the dictum, "The more teeth the longer life." "The fewer teeth the shorter life," said Aristotle about one hundred years later.

In 1618 Hilkiah Crooke published a work *Μιχροχοσμογραφια*, in which he gives the views of the best anatomists. In this it is observed that there are sometimes four and sometimes five grinders.

On second Dentition the author says: "The shearing (*i.e.*, incisors) teeth, when they do break forth, do thrust the first shearers out before them and issue betwixt the first two, the second and the dog tooth that is next unto them. But if the former teeth will not fall or be not pulled out, or if the latter issue before the first fall, then the latter make their way through new sockets and turn in the upper jaw outward, in the lower jaw inward, so that there seemed to arise a new row of teeth, and this indeed hath deceived many historians and anatomists also."

Barth Ruspini, in 1750, says: "All the teeth that exceed thirty-two may be regarded as supernumerary." He attributes irregularity of canines and incisors to extreme narrowness of the jaws.

Robert Blake, in a translation of his inaugural Dissertation, published in 1798, speaks of supernumerary and inverted teeth.

Joseph Harris, "A Familiar Treatise on the Teeth," 1830: "Irregularity is due to supernumerary teeth."

John Winckworth, 1831, speaks of supernumerary teeth causing irregularity.

THUMB-SUCKING, AND SIMILAR CAUSES.

J. Imrie, *Parents' Dental Guide*, 1834: "Irregularity is due to want of development of jaw-bones, intemperance of various kinds combined with artificial modes of living introduced by civilization, and sudden transition from heat to cold to which the teeth are subject—all these have a tendency to prevent development of the bones. Rabbit mouth is due to keeping the thumb in the mouth for hours, after going to sleep. Underhung jaw is due to 'sucking the tongue,' by throwing the under jaw-bone from its articulation. A similar state of the teeth and jaw-bones is induced when attempts are made by the inexperienced to regulate them by the extraction of teeth in the upper jaw and neglecting to remove an equal number in the lower."

J. Lefoulon, "A New Treatise on Theory and Practice of Dental Surgery" (translated from the French by Thomas Bond, 1844): "Among the causes of Dental Irregularity we may regard as the most frequent, the neglect of proper supervision of second Dentition. Very often the temporary teeth are too precipitately removed and again the opposite error is committed of suffering them to remain even after the permanent have partly appeared. There results from this an error of relation between the development of the palatine arch and the superior alveolar border, or of the two arches at once, relatively to the size of the teeth. Another cause is the bad habit of permitting children to suck their thumbs and continually to be putting their hands into their mouths. Another is the frequently repeated action of the tongue in the pronunciation of certain syllables called lingual, in which that organ, striking against the anterior superior teeth gives rise to anterior obliquity of the superior arch. We may remark that this deformity is very frequent

with the English, resulting from the pronunciation of lingual syllables."

About the same year Dr. Thos. Ballard claimed certain peculiarities, such as serrated teeth and projecting jaws, to be the result of fruitless sucking.

Stockton's *Dental Intelligencer*, 1845, from the "Forceps:" "The comparative ease by which, with pressure, the incisors or bicuspids may be made to alter their position, would naturally suggest the idea that the tongue, lips or cheek might, in some measure, influence their original direction; but as these are pressed by every one, while certain individuals only have their teeth unevenly arranged, we may look for some other accessory; and this may be found in the form of the palate, certain peculiarities of which are found in connection with similar forms of the dental arch. Irregularity of position is almost exclusively confined to anterior five teeth on each side of the medial line, brought about by pressure of tongue upon hard palate in sucking or mastication."

Nasmyth's "Researches on Development, Structure and Diseases of the Teeth," 1845: "Projecting upper jaw is often the result of a habit of sucking the tongue or finger in infancy. But both projecting upper and projecting lower jaw arise from an arrest of development in the jaw when expansion of the arch is deficient." He also states that we find the prominent mouth in uncivilized races.

The theory that irregularity may be due to thumb-sucking, so much made of in modern times, was mentioned by different writers during the last forty years. Among these H. D. Ross speaks of it in 1853. At the same time he remarks, what must have been observed as soon as there was an attempt at correction, that there is greater difficulty in keeping teeth in position after they are moved than in moving them.

A. A. De Lessert, 1873, attributes deformity to fruitless sucking and to enlarged tonsils, which necessitate an open mouth.

Thomas Salter, "Dental Surgery," 1874, attributes irregularity to hypertrophy of tongue and thumb-sucking.

J. W. White, 1879, says that the protrusion of lower jaw is due to the habit of sucking the first and second fingers; the weight of the hand and arm causing a protrusion of lower jaw and teeth.

Mr. Francis Fox, "Irregularity of Teeth and their Surgical

Treatment," 1880: Causes of irregularity are "want of proportion in the size of the teeth and jaw-bones or prolonged retention of temporary teeth, supernumerary teeth, habit of thumb-sucking or undue pressure from an hypertrophied tongue, or heredity."

RETENTION OF TEMPORARY TEETH.

Thomas Berdmore in 1768 says that the cause of supernumerary teeth or a double row of teeth is due to the fact that the milk-teeth are never shed, notwithstanding the fact that the permanent teeth appear. Irregularity of teeth is due to the resistance offered the permanent by the temporary, which also occasions snaggled, rough and indented teeth.

Joseph Fox, "Natural History of Human Teeth," in 1803: "Most frequent cause of irregularity is a want of simultaneous action between the increase of the permanent teeth and the decrease of the temporary ones by the absorption of their fangs, most commonly occasioned by the resistance of the nearest temporary teeth; also from the fact that the permanent teeth are too large for the space occupied by the temporary. The growth of more teeth than the natural number frequently occurs, and is always the cause of great irregularity of the teeth."

Joseph Murphy, in "Natural History of the Human Teeth," speaks of irregularity due chiefly to the first teeth not having been shed in time.

Benjamin James, in "A Treatise on the Management of the Teeth," 1814, says: "With proper attention paid to the removal of the first set of teeth, the regularity of the second set may be anticipated."

Parmly, in "Lectures on Natural History and Management of the Teeth," 1820, states that: "Want of attention during the period of shedding the first set of teeth is great cause why irregularity of the teeth and consequent deformity of the mouth are apt to take place." "When the permanent teeth are large and growth of the jaw does not proceed in a corresponding proportion, they are found to crowd and overlap each other."

G. Waite, "Surgeon-Dentists' Anatomical and Physiological Manual," 1826: "Irregularities of the teeth are mostly occasioned by the pressure of the temporary upon the permanent, throwing them in a wrong direction."

S. S. Fitch, "System of Dental Surgery," 1835: "Irregularity is due to want of simultaneous action between the increase of the permanent teeth and the decrease of the temporary by the absorption of their fangs; to the greater size of the permanent in comparison with the temporary."

"Treatise on Diseases of the Mouth," by J. B. Garriot, 1843, translated by J. B. Savier: "Deciduous teeth, by their presence, often prevent the permanent teeth from arranging themselves in their proper position. Should we neglect to extract the milk-teeth and other measures capable of favoring a good arrangement of the permanent teeth, deformity—often very serious—may ensue."

GROWTH OF MAXILLÆ.

Hunter, in 1771, in "Natural History of the Teeth," speaks of supernumerary teeth; he states that the jaw grows *at the posterior edges,* and that irregularity is often due to the ten anterior permanent teeth being larger than the ten anterior temporary teeth, while the corresponding part of the jaw is of the same size; therefore in such cases the second set is obliged to stand very irregularly."

G. M. Humphrey made observations on the mode of growth of the lower jaw. He claims there is no interstitial growth. The five permanent front teeth occupy exactly the same position throughout life, and all other additional teeth are added to the hinder end of the jaw. This hind end is enlarged by the absorption of the anterior coronoid edge and the deposition on the posterior edge. When the molars are first formed they are under the coronoid process, and are subsequently exposed—theories proven by experiments on young pigs.

SLEEPING WITH THE MOUTH OPEN.

Tomes, in "Dental Surgery," 1859 and 1870, mentions the fact that deformity is caused by sleeping with the mouth open. He makes no mention in edition of 1848.

W. Matthews, 1880, in paper read before Students' Society of the Dental Hospital of London, attributes irregularity to enlarged tonsils, which necessitate breathing being carried on with open mouth; also to heredity, maxillæ being smaller in proportion than the teeth, which is due to the lessened work of maxillæ and teeth by civilized races; also cross-breeding and thumb and lip-sucking, retarded shedding of temporary teeth and too early extraction of first perma-

nent molars. "Congenital V-shaped jaw is that form in which, previous to birth, the form of the upper maxillæ is such that its cornua do not diverge posteriorly, but are parallel, and as that portion of the jaw already formed never changes its form, the newly-added parts will pass off in divergent lines, forming an angle with that previously existing, in order to correspond with the increasing width of the base of the skull."

PREMATURE EXTRACTION OF TEMPORARY TEETH.

L. Koecker, 1826: "The deformity which consists in shutting the under incisors and cuspidati over the upper, has been produced by the injudicious extraction of some of the teeth of the upper jaw, without taking proper care to secure a due proportion between the upper and under jaws." We have irregularity also when the temporary teeth are not extracted in time, and when we have too long persistence of temporary.

Thomas Bell, "Anatomy, Physiology and Diseases of the Teeth," 1829: "Most unusual cause of permanent irregularity is the actual want of sufficient room in the jaw of the ultimate regular arrangement of the teeth, and this may occur from disproportionate narrowness of the jaw (whether from original formation or produced by too early removal of temporary teeth) or from preternatural size of the permanent teeth."

Joseph Scott, "Art of Preventing Loss of Teeth," 1831: "Irregularities arise from—first, a natural want of sufficient expansion in the jaw-bone at the time of their protrusion; second from not extracting the temporary teeth at the proper time; third, by too early an extraction of the temporary teeth; fourth, from supernumerary teeth."

John Nicholles, "Teeth, in Relation to Beauty, Voice and Health" 1833: "Deformity may be due to too long persistence of temporary teeth, or may arise from some malformation of the teeth or jaw, entirely beyond the previous control of the dentist."

R. Maclean, "Treatise on Human Teeth," 1836: "Due expansion of the jaw is prevented by premature extraction of the temporary teeth, the permanent thereby becoming crowded and irregular."

E. Spooner, "Popular Treatise on the Teeth," 1836: "First and most frequent cause of irregularity is a want of simultaneous action

between the protrusion of the permanent teeth and absorption of the fangs of the temporary. Second cause is a narrowness of the maxillary arch or a want of proportion between the extent of it and the size of the teeth. Another cause is by the premature extraction of the temporary teeth; the jaw is liable to contraction, and when the permanent teeth come in there will not be room in the jaw for them. Irregularity is also due to supernumerary teeth."

Wm. Thornton, "A Popular Treatise on the Preservation of Teeth and Gums," 1836: "Irregularities of the teeth proceed from three causes,—first, from a natural want of sufficient expansion in the jaw-bones at the time of the protrusion of the teeth; second, not extracting the temporary teeth at the proper time; third, too early an extraction of the temporary teeth."

Mortimer, 1836: "Irregularities arise from natural or accidental causes."

Natural causes arise from a bad conformation of the jaw, so that several teeth are over each other; from the teeth being much larger than they should be; from coming out of order and place; from teeth growing out of the palate or projecting into the mouth.

"*Accidental* causes arise from neglect or ignorance in removing milk-teeth too soon; when the second teeth from some internal cause take a direction inwards or outwards; underhung jaw arises from making faces."

Charles De Loude, "Surgical, Operative and Mechanical Dentistry," 1840: "Irregularity is due to supernumerary teeth, to second teeth being too large and maxillary arch too narrow, and to too early extraction and too long persistence of temporary teeth, and to shape of the maxillary arch, and to heredity, where the child inherits the jaw of one parent and the teeth of the other."

Sam Ghimes, 1843, speaks of the underhung jaw being due to the upper incisors extending inwards, and on closing the mouth they come in contact with the lower; this makes the child inclined to protrude the lower jaw, which finally becomes habitual, and promotes the increase in the length of the jaw itself.

Early French writings contain little or nothing on the subject. In a German work—"Nessel's Compendium der Zahnheilkunde," 1856—the cause of irregularity is attributed to the premature extractions of temporary teeth. The alveoli, it is stated, form a bone-scar in such cases, which is an obstacle to the advancement of the

permanent teeth. In consequence, it is claimed, the permanent teeth come before the jaw is sufficiently expanded to receive them.

DEVELOPMENT OF SPHENOID.

J. L. Down, "Relation of Teeth and Mouth to Mental Development," 1871, wrote: "Excessive vaulting of palate, due to arrest of development of the sphenoid or defective growth of vomer. The defects are developmental defects, and betoken a cause long anterior to the time when sucking the thumb is practiced, unless that habit be an intra-uterine one."

Mr. Oakley Coles, "Origin and Treatment of Certain Irregularities of the Teeth," 1881, before International Medical Congress, said his observations in regard to intermaxillary prognathism were based on the authority of Mr. Hilton.

Dr. Oakley Coles expressed the opinion, held by others about the same time, that the best types of English jaw give an equilateral triangle. He applied Greek names to the different classes into which he divided various forms of arches; he gave no basis for his classification except that of form. He attributed intermaxillary prognathism to a force originating in the sphenoid bones and acting on the intermaxillary bone, and held that premature ossification of the sutures operates powerfully in the production of oral deformity.

ATTRIBUTED TO CIVILIZATION.

J. P. Clark, "A New System of Treating Human Teeth," 1829: "Irregularity may arise from too premature extraction of temporary teeth. Disproportion between the teeth and the jaws may be occasioned by a natural conformation of the parts or may be the unnoticed effect of accident. For we seldom find any such disproportion and consequent irregularity in the teeth of men and animals in a wild state."

J. L. Levison, in "Jaws and Teeth of Semi-barbarous Men," 1852: "The jaws of civilized men are more contracted than those of semi-barbarous races, and this is the result of the direct violation of the Creator's laws, who willed that the brain and nervous system of the growing child should not be overtaxed, and that the dental process of attempting to build up the organic instruments and cultivate the mental faculties at the same time is a matter almost impossible to accomplish."

In *British Journal of Dental Science* of 1864 an extract of George Catlin's "Breath of Life" is given. In this he states that malformations of teeth are due to keeping the mouth open, as *civilized* man is the only animal who keeps his mouth open during sleep.

Mr. Mummery and Mr. Nichols made extensive observations in 1860 on the teeth of savage races. They report that irregularities of the teeth and contracted jaws were rare. Mr. Nichols found but one case of slight irregularity among the thousands of Indians and Chinese which he examined. Messrs. Coleman and Cartwright examined a large number of skulls in the crypt of Hythe Church in Kent. These were very old, though their history is not known definitely. All of them had well-developed jaws and alveolar arches, and the teeth that were still present were remarkably regular.

About 1864 Mr. Samuel Cartwright read an able paper before the Odontological Society of Great Britain. In this he expresses his views that irregularities result from selective breeding; that they are both congenital and hereditary; that there is very little increase in the anterior part of the jaw after eight or ten years; that if the temporary teeth were to remain, the jaws would not change from those of childhood; that in all cases of irregularity the maxillæ are more or less altered in proportion of development, whilst the teeth maintain, in regard to their size, an average development.

Mr. Hepburn, in "Irregularities of Teeth and their Treatment," 1870, says: "Contracted maxillæ and alveoli are the result of artificial life and other causes attendant on civilization. Ethnologists affirm that with the advance of civilization, there is decrease in the size of the facial and maxillary bones." Deformity is also attributed to cross-breeding.

Among comparatively recent works on irregularities, that by Kingsley on "Oral Deformities" is one of the most important. He attributes irregularities chiefly to premature extraction of temporary teeth, intermarriage between persons of different nationalities, hereditary and disturbed innervation.

CONSTITUTIONAL CAUSES.*

John Fuller, 1810, attributes irregularity to too long persistence of temporary teeth; he also says that the upper jaw is too small for

* This term, used by the author, is explained in chapter III.

the permanent teeth, which fact often occasions irregularity. "Some children have the habit of projecting the under jaw forward, and, of course, shutting one or more of the under front teeth beyond the upper, which soon becomes permanent."

Mr. Sigmond, in "Treatise on Diseases and Irregularities of the Teeth and Gums," 1825, attributes irregularities to—1. Natural; 2. Accidental causes. "Natural, (1) when they result from the jaw not expanding sufficiently to allow the teeth to form a regular circle; (2) when they are larger than the ordinary dimensions; (3) when they do not appear in their proper order and place. Accidental, when caused by negligence or improper treatment at the time of their growth."

Andrew Clark, "Practical Directions for Preserving the Teeth," 1825: "That irregularity of the teeth is occasioned by want of room in the jaw, and not from any effect that the first set produce upon them, is evident because, in all cases of irregularity, we find that really there is not room to admit of placing all the teeth properly."

William Robertson, "A Practical Treatise on the Human Teeth," 1841, says: "Deformity is due to inheriting the contracted jaw of one parent and the large teeth of the other."

Savier's translation of F. Maury's "Dental Art" 1842: "Prominence of upper jaw is due to narrowness of the arch; recession, due to the anterior teeth."

C. A. Harris, "Principles and Practice of Dental Surgery," 1845: "An infringement of laws of growth or disturbance of the functional operation of any of the organs of the face or head may determine an improper development of the jaws and a bad arrangement of the teeth." He also mentions supernumerary teeth and irregular individual teeth; he attributes irregularity of the teeth to the narrowness of the maxillary arch, and sometimes to the presence of temporary teeth.

Arthur, "A Popular Treatise on Diseases of the Teeth," 1845: "Irregularities of the teeth may proceed, amongst others, from three principal causes: First, the presence of a greater number of teeth in the mouth than is natural; second, a deficiency of space in the jaws; third, a wrong direction given to one or more at the time they make their appearance. A deficiency of space may arise from a contraction of the jaws in consequence of the too early ex-

traction of the temporary teeth; from some original malformation of the jaws, or from a great excess in size of the second set over the first."

W. K. Brideman, 1845, "On Causes of Irregularity of the Teeth," denies the aid of the tongue, lips or cheek in influencing the teeth from original direction; but attributes it to shape of the jaw.

Sam Harbert, 1847: Irregularities of teeth are due to premature extraction of deciduous teeth and protrusion of permanent before the absorption of a deciduous fang. A projection of lower jaw is attributable to neglect in second dentition; generally it is supposed to be due to elongation of the jaw, which is almost always an error. When the dental arch becomes contracted at the medial line, giving to the mouth a pointed appearance, it is often the result of premature extraction of certain of the temporary teeth. "Practical Treatise on the Operations of Surgical and Mechanical Dentistry."

Alfred Canton, 1851, "Teeth and their Preservation:" "Irregularity of teeth, as regards their shape, position, direction, crowded condition, etc., are met with more frequently than is supposed to be the case. Causes are chiefly mechanical, depending either on the non-increase in size of the jaw in proportion to the growth of the teeth to be contained in the alveolar arch; on the position of the permanent teeth with reference to the fangs of their predecessors, and lastly, on the increase in size of one jaw in preference to the other."

"Treatise on Second Dentition," by C. F. Delabarre, translated for *American Journal of Dental Science:* "Malconformation of denture may be occasioned, first, by a defect in the conformation of the jaw; second, by the simple want of their development depending upon the health of the individual; third, by an excess in the development of all the teeth, though the jaws are in other respects well formed; fourth, by rapid development of the dentition of one set and delay in that of the other; fifth, finally, by the too great size of the teeth of one jaw, which do not harmonize with those that are opposite." "Some forms of defective palatine arches are hereditary."

J. R. Duval, "The Youth's Dentist:" "In a projecting chin the alveolar arch, in which the incisors and canines are placed, has

taken a development upon a parabolic line, greater and more prominent than that presented by the body of the bone; this differs very little from a similar one in upper jaw, which projects over the lower. Upon attention to shedding of temporary teeth depends the fine arrangement of the lower."

Dr. Gunnell, in *American Journal of Dental Science*, states that protrusion of lower jaw is in many cases hereditary; but often is brought about in this way—the incisors of the lower jaw are cut first, and when the upper ones make their appearance the lower have nearly arrived at their full growth. In closing the mouth they come in contact with the gum on the inside of the upper incisors, and for relief the lower jaw is thrust out, which soon becomes permanent.

Samuel Cartwright, Jr, in lecture delivered before King's College, reported in *British Journal of Dental Science*, in June, 1857, says, the "irregularities of permanent teeth are due, first, to non-absorption of the roots of temporary teeth in proportion to the rise of those of replacement; second, the great difference which commonly exists in the size of the new teeth as compared with those of the first set; third, contraction of the arches of the jaws and other malformations of maxillary and palate bones, originating in hereditary, congenital and other causes."

A. A. Blount, "Orthodontia," 1866: "Remote causes which produce irregularity will be found in the commingling of all nations, with national and individual characteristics. Most frequent causes are the result of accident, indiscriminate extraction of the deciduous teeth and too early extraction of permanent teeth."

H. Sewell, "Irregularities and Diseases of the Teeth," 1869: "Protrusion of incisors is due apparently to an abnormal development of premaxillary bone." Irregularities are due to "retention of temporary teeth, causing permanent teeth to assume an unnatural position, also to malformation of jaw, which are usually congenital and at the same time hereditary; may, however, be due to injury or other accidental causes."

WANT OF PROPORTION BETWEEN JAWS AND TEETH.

David Jobson, "On the Teeth," 1834: "Irregularity is due to smallness of maxillary arch and great size of permanent teeth and

their situation, part on inner and of others on outer side of temporary teeth."

John Mallan, " Practical Observations on Physiology and Diseases of the Teeth," 1835: " Now the adult teeth being larger as well as more numerous than the milk teeth, it is obvious that they require a great deal more room, and when the absorption of the latter does not progress equally with the growth of the former, the new teeth are crowded up and are apt to be forced out of their natural position by the resistance of the old. Again, if the permanent prove, as they sometimes do, disproportionately large in comparison with their predecessors, the jaw may not be sufficiently extended to admit of their being arranged in regular order, in which case some overlap the others and considerable deformity is occasioned."

Paul Goddard, "Anatomy, Physiology and Pathology of the Teeth," 1844: "Most prolific cause of irregularity is the want of room in the dental arches—this arises sometimes from a congenital defect, but more commonly from early decay and loss of the temporary teeth, which failing to keep up the alveoli, enables the jaw to contract and thus afford too little room for the permanent set."

CHAPTER II.

THE ALVEOLAR PROCESS.

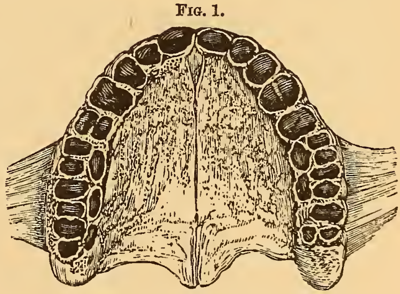
THE alveolar processes are situated upon the superior border of the inferior maxilla and upon the inferior border of the superior maxilla. These bones are considered a part of the maxillary bones, and are so described by anatomists. They should, however, be considered and described as practically separate and distinct bones. Their structure and functions differ so completely from the structure and functions of the maxillary bones that there is little or no similarity between them. The superior and inferior maxillæ are (unlike the alveolar processes) composed of hard, compact bone-structure. The large, powerful muscles attached to them would indicate that powerful work is to be accomplished, and when fully developed they retain their full size through life. The alveolar processes are composed of soft and spongy bone of a relatively cancellous structure. As early as the eleventh week of intra-uterine life, calcification of the deciduous teeth commences, and by the twentieth week calcific material is quite abundantly deposited. Ossification is also rapidly progressing about the dental follicles. At birth the sacs are nearly or quite enclosed in their soft bony crypts, and the crowns of the teeth upon their outer surface are composed of enamel, which is dense and hard.

The alveolar process, being soft and spongy, molds itself about the sacs containing the crowns of the teeth and about their roots after their eruption, regardless of their position in the jaw. While the alveolar processes have grown rapidly, they have, up to this time, developed only sufficiently to cover and protect the follicles while calcification proceeds. When the crowns have become calcified and the roots have begun to take in their calcific material, absorption of the borders of the processes takes place in the order of the eruption of the teeth. When the teeth have erupted, the alveolar process develops with the teeth until they attain the depth of the roots of the teeth, which extend in most instances into the superior maxillary bone in the anterior part of the mouth at least. The

depth to which they penetrate the bone differs in different mouths. The *incisive fossa*, the *canine eminence* and the *canine fossa* give evidence of this externally. These sockets are lined with extensions of the process, thus making its upper border irregular. The fact that some of the teeth are fixed in the bone as well as in the alveolar process makes the correction of some forms of irregularity more difficult, for not only does the process have to be reshaped but the bone as well. This is quite noticeable in correcting irregularities of the teeth in the lower maxilla. The crypts of the permanent teeth are located at the apices of the roots of the temporary teeth. The permanent teeth have large crowns which touch each other forming a line to the posterior part of the jaw. These teeth, as they erupt entirely absorb the alveolar process which surrounded the temporary teeth, and, as the new set come into place, a new process is built up about them for their support. The permanent teeth require a deeper alveolar process to support their roots, which are much longer than those of the temporary teeth. Hence the difference in the depth of the arches of the first and second sets of teeth.

The alveolar process of each superior maxilla includes the tuberosity, and extends as far forward as the median line of the bone, where it articulates with the process upon the opposite side. It is narrow in front, and gradually enlarges until it reaches the tuberosity, where it becomes rounded.

Fig. 1.



If we examine the two articulated superior maxillary bones (Fig. 1), we see that the anterior part is curved, while the posterior part gradually diverges from the central line of ossification of the maxillary bones. The shape varies in different individuals. Some arches are small and others large; the arch is parabolic in some cases and circular in others.

The process is composed of two plates of bones, an outer and an inner, which are united at intervals by septa of cancellous tissue. These form the alveoli for the reception of the roots of the teeth. In some cases the buccal surfaces of the roots of healthy teeth extend nearly or quite through the outer bony plate.

This plate is continuous with the facial and zygomatic surfaces of the maxillary bone. The inner plate is thicker and stronger than the outer, and is fortified by the palate bones. The external plate is irregular upon the outer surface, prominent over the roots of the teeth, and depressed between the roots or interspaces.

The prominence over the canine teeth, called the canine eminence, is very marked, and decidedly modifies the expression of the face. The sockets of the central incisors are conical and round, those of the lateral incisors conical and slightly flattened upon their mesial and distal surfaces, and not so large as the central sockets.

The pit for the cuspid is conical and much larger than any of the other sockets. The sockets for the bicuspids are flattened upon their anterior and posterior surfaces, and near the apex they are frequently bifurcated. The sockets of the molars are large at the openings, but at about the middle of their length they are divided into three smaller sockets for the reception of the roots. In the case of the third molar the number of sockets ranges from one large cavity to three or four of smaller size.

THE INFERIOR ALVEOLAR PROCESS.

The alveolar process of the inferior maxilla extends from the ramus of one side to the same point on the other. The outline is similar to that of the superior process, the anterior portion being much thinner.

The description given of the structure of the superior process will also apply to the inferior. The outer plate of bone opposite to the molars and bicuspids is thicker than the inner plate, while the inner plate opposite the canines and incisors is thicker than the outer.

The alveoli are arranged along the border of the bone for the reception of the roots of the teeth. They correspond in form to the roots which they accommodate. The alveoli for the central incisors are smaller than those for the lateral. They are conical in shape, and flattened upon their mesial and distal surfaces. Those for the lateral incisors are larger, and compressed on their mesial and distal surfaces. The sockets for the canines (cuspids, or stomach teeth) are larger, deeper and less compressed than those for the incisors.

The sockets of the bicuspids are considerably flattened upon their lateral surfaces, and are sometimes divided into two cavities. The sockets for the anterior roots of the molars are broad and flattened laterally, while those for the anterior roots are round. The third molar, being naturally of variable form, has sometimes one pit, and again three or four. Each alveolar pit or socket is divided from its neighbor by a small wall or septum, which is made up of cancellated bone, extending about one-eighth of an inch above the inner and outer plate.

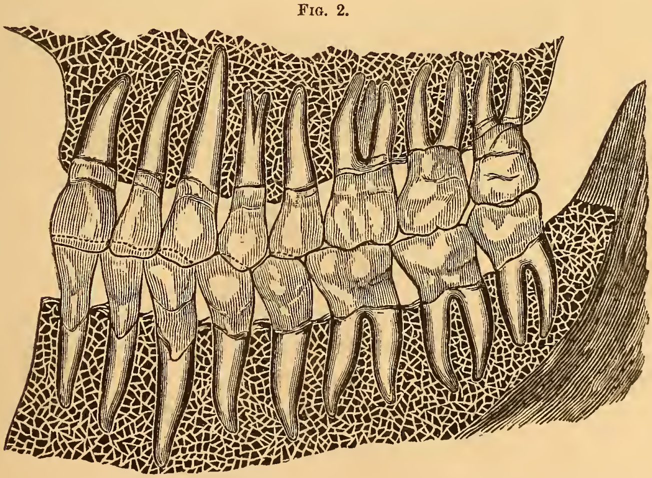
The dental septa assist in keeping the teeth firmly in their places.

It will be observed that the septa are very thin at the margin, and gradually increase in width to the middle of the jaw, where they become thicker, and are finally lost in the substance of the jaw. Some septa are thicker than others, and where two teeth are widely separated, the width of the septa naturally corresponds to the space between the teeth.

The sockets are lined with a thin plate of compact bony substance, extending from the outer and inner plate of the alveolar process to the apex, where there are small openings for the entrance of nerve and blood-vessels for the nourishment of the teeth.

This bony plate has upon its inner surface the elastic peridental

Fig. 2.

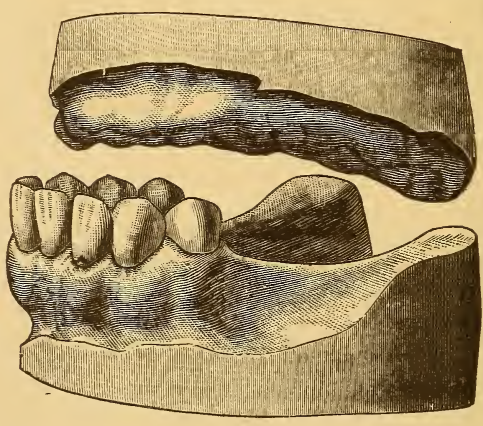


membrane, which acts as a cushion for the teeth, while upon the inner surface it is surrounded by spongy bone.

The teeth are held firm in their alveolar sockets by a union called gomphosis, which resembles the attachment of a nail in a board. Teeth with one conical root, and those with two or more perpendicular roots, are retained in position by an exact adaptation of the tissues. Teeth having more than one root, and those bent or irregular, receive support from all sides by reason of their irregularity. The teeth are also held in position by the peridental membranes. Fig. 2 illustrates the position of the teeth in the jaws. The peridental membrane lines the alveolus and covers the roots of the teeth. It is a fibrous tissue, which admits of a slight motion of the teeth, and acts as a cushion to protect the jaws from severe blows and concussions while in the act of tearing and grinding food.

After the removal of the permanent teeth the alveolar process is entirely absorbed. Fig. 3 shows how absorption takes place. The teeth have all been removed from the superior maxilla, as has also

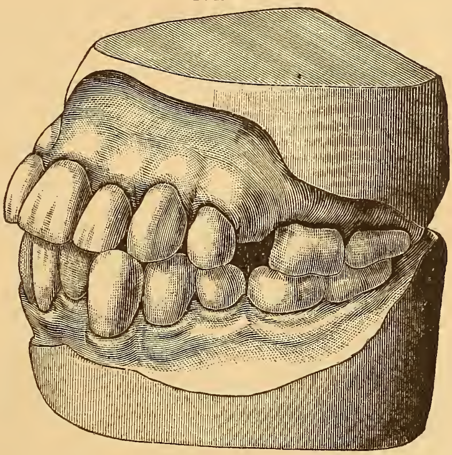
Fig. 3.



the alveolar process. The molars on the lower jaw have been extracted and absorption of the alveolar process has resulted, showing a marked contrast in connection with the anterior alveolar process, which remains intact and holds the teeth firmly in place. Thus it will be observed from the changes which occur from the first development of the teeth to their final extraction, that the alveolar process is solely for the purpose of protecting the teeth in their crypts during their development and after their eruption. When the temporary teeth are in place the alveolar process remains unchanged

(except a gradual enlargement in harmony with the growth of the maxillary bones) until about the sixth year, when the second set of teeth appears. The crowns of the permanent teeth require more space than those of the temporary set; and the alveolar process must necessarily enlarge to accommodate them. This enlargement

Fig. 4.

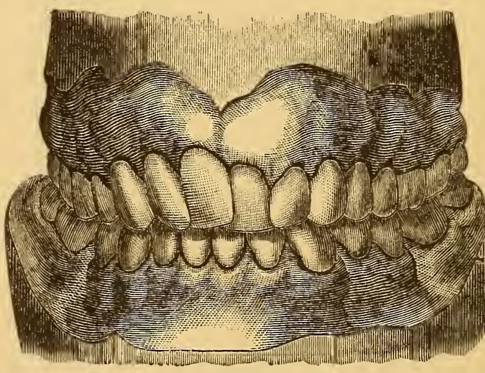


of the alveolar process is doubtless caused by the formation of the crowns of the permanent teeth before eruption, and to a limited extent by the growth of the maxillary bones, which may cease developing at any period in the life of the individual, or continue as late as the thirty-sixth year. The diameter of the crowns of the permanent teeth forming a larger circle than that of the maxillary bones, the alveolar process must necessarily increase its diameter. It is often forced outside of the superior maxilla by the crowns of the permanent teeth crowding and wedging themselves into positions anterior to the first permanent molar teeth. This enlargement of the alveolar process usually takes place anterior to the first permanent molars. We expect to find the process corresponding in size to the jaws. Fig. 4 shows a comparatively small superior maxilla, the inferior being much larger. This is the result of arrested development. To allow for the deficiency in bone-structure and allow the upper teeth to extend over the lower, the upper teeth have forced the alveolar process forward. The space shows where a tooth was extracted after all the teeth were in position.

Fig. 3 shows a similar case where all the upper teeth have been removed and absorption has entirely obliterated the alveolar process The relations of the superior maxillary bones to the alveolar process and teeth on the lower jaw are well illustrated. When the alveolar process and teeth were intact they presented an appearance like illustration No. 4.

The position and shape of the processes and their relation to each other are governed entirely by the location and size of the teeth and roots, and not by the shape of the jaw-bone proper. The dental follicles containing the crowns may be located upon the outer border of the jaw-bone on one side, in which case the alveolar process will be

FIG. 5.



situated upon the outer border and assume an irregular arch. If the crowns of the teeth are located upon the inner border, or if one jaw be smaller than the other, the teeth will articulate and the process will form a smaller circle than the jaw-bone proper. Such a case is illustrated in Fig 5. The superior maxilla is much larger than the inferior, and, as a result, the articulation of the teeth and the muscles of the cheeks and lips have carried the teeth and alveolar process on the upper jaw inward. The teeth on the lower jaw are regular and appear to have sufficient room, while those upon the upper jaw are crowded and overlap each other. The teeth on the left side of the upper jaw are more regular than those on the right side. Upon examining the mouth or model, the arch on the left side will be found full and regular, while the arch upon the right side has a perfect semi V-shape.

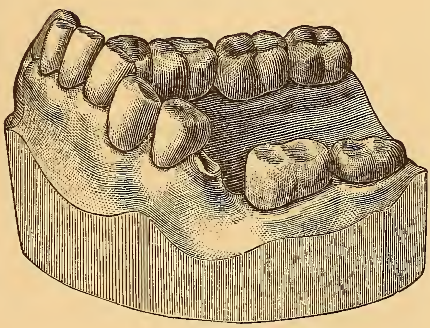
The alveolar process on the right side extends considerably over

the border of the maxillary bone, and the teeth (especially the cus id) have taken quite an incline in order to articulate with the teeth upon the lower jaw, thus crowding the alveolar process to the inner border of the maxillary bones.

The process is solely for retaining the teeth, and if for any reason the dental follicles should not be present and the tooth should not erupt, or if it should have been extracted early. the process would not be developed at that point. In my collection of models may be seen cases of arrested development of the alveolar process, caused by the lack of bicuspid and lateral incisor germs, and by the extraction of the deciduous and permanent teeth.

If one or more teeth should not antagonize, the alveolar process would extend beyond the natural border, carrying the teeth with it. A marked illustration of this is seen where the molars are decayed to the gum and the roots remain. The vascularity of the process is such that its development results. Excessive development of the

Fig. 6.



alveolar process is frequently observed by every practitioner in connection with the anterior inferior teeth. When the articulation is normal, occlusion of these teeth never takes place. We frequently find (especially in patients from ten to sixteen years of age) these teeth extending to and occluding with the mucous membrane of the hard palate, making one of the most difficult forms of irregularities to correct. Such a case is illustrated in Fig. 6. This model is taken from the jaw of a person thirty-seven years of age, but I venture the statement that this excessive development took place between the ages of ten and sixteen, because at that period the vascularity of the tissues is more vigorous and the development of the process more

formative than at any period subsequent to the development of the first permanent teeth.

I recall a case in practice in which the incisors and cuspids, together with their alveolar process, are situated upon the external surface, while the bicuspids, molars and their alveolar process are located upon the inner border of the jaw. Another case is one in which the alveolar process failed to cover the roots of the bicuspids and molars upon the outer surface, the teeth having forced themselves into a larger circle through the alveolar process by the contact of the crowns. The roots in this case can be easily outlined by the finger through the mucous membrane, the outer plate of the alveolar process barely, if at all, covering them. Mr. Tomes mentions and illustrates a case in a late work of faulty development of the outer plate of the alveolar process exposing the crowns of all the temporary teeth. The case was a child who had suffered from hydrocephalus. I have a number of models showing the anterior alveolar process projecting beyond the normal position by the forward movement of the molars. This may be due to a natural movement of the molars forward, or the process may be forced forward by the improper occlusion of the jaws. The teeth are moved from one position to another simply by the force consequent upon absorption and deposition of bone. This is noticeable in the spaces between the centrals, when the alveolar process develops to a larger circle than is necessary to accommodate the teeth. The alveolar processes are influenced in one direction or the other by the pressure of articulation. This abnormal condition is the result of inharmonious development of the jaws. The teeth may come together in such a manner as to throw the alveolar processes either to the right or left, thus producing a full round arch upon one side of the jaws and a perfectly flat or straight arch upon the other. (See Fig. 5.) The greatest deformity is that in which the teeth of the upper jaw and alveolar process are forced forward, causing a protrusion of the anterior superior part of the mouth. Occasionally we find both upper and lower alveolar processes carried forward in the same manner. The alveolar process upon the lower jaw is more liable to be found upon the inner border of the jaw than is the upper alveolar process, as the inferior maxilla is larger and more dense than the superior, and when the teeth are once in position upon the lower jaw they are not liable to subsequent change. Owing to this

fact the teeth of the superior maxilla do not form so great a circle, causing the teeth upon the sides of the jaws to conflict and the lower teeth and alveolar processes to be carried in, while the anterior teeth of the lower jaw are held inside of the superior anterior teeth, thus carrying the alveolar process inward.

The teeth are continually changing their positions in the mouth. This is beneficial as often as it is detrimental. That the teeth may perform their full function, they should not only remain firmly fixed in the alveolar process, but they should also antagonize. The teeth may be compared to the bricks in an arch. Remove a brick and the arch falls to pieces. It is frequently found that the teeth do not articulate properly, and by cutting away the approximal surfaces a better articulation may be secured. When this operation is performed, the teeth move in their sockets by absorption and deposition of bone, demonstrating the fact that the process changes in shape and substance.

HYPERTROPHY OF THE ALVEOLAR PROCESS.

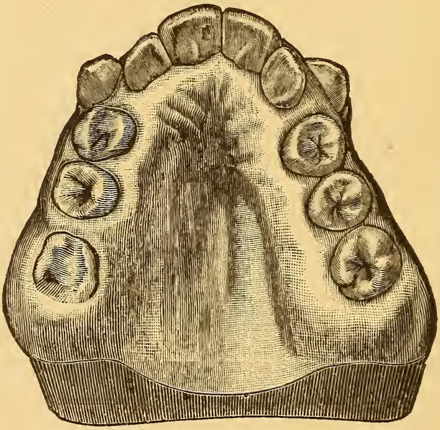
From what has already been said of the vascularity of the alveolar process, we may expect to find hypertrophy of the tissue ensuing from simple irritation of varying degree. The irritation consequent upon the eruption of the teeth, together with the excessive blood-supply, are both primal causes of over-building of tissue, *i.e.*, hyperplasia.

The ragged roots of the temporary teeth, produced by absorption, the gases from the putrescent pulps, and the pressure of the permanent crowns against the tissues, produce sufficient stimulation to excite physiological action. Tissue-building generally is seen in connection with the teeth posterior to the cuspid, rather than with the teeth anterior to that tooth. It seems accountable only from the fact that the incisors have sharp cutting-edges, the roots of the teeth are single and nearly always shed before the permanent teeth are in place, and they erupt at an age when there is less vitality. *Per contra*, the crowns of the teeth posterior to the cuspid are broad, the roots of the temporary teeth posterior to the cuspids are more numerous than those anterior to them, and, with the exception of the first permanent molars, they erupt at the age of greatest vitality. The process becomes unnaturally thick, the bicuspids and molars are carried in one direction and another, effecting a variety

of irregularities. A common form is shown in Fig. 7. Similar irregularities are also seen in Cole's "Deformities of the Mouth," Figs. 12, 13, and 27; and in Tomes' "Dental Surgery," Fig. 90. These deformities all take the contour of the saddle-shaped arch. This may be accounted for from the fact that the permanent molars being the first teeth to erupt, they become fixed before the deposit commences. The crowns of the bicuspids are also held in a small circle by the retention of the temporary molars. When these teeth do not antagonize, they are liable to be carried inward.

The cuspids with their long roots meet resistance either in connection with the teeth adjoining or with those upon the opposite jaw,

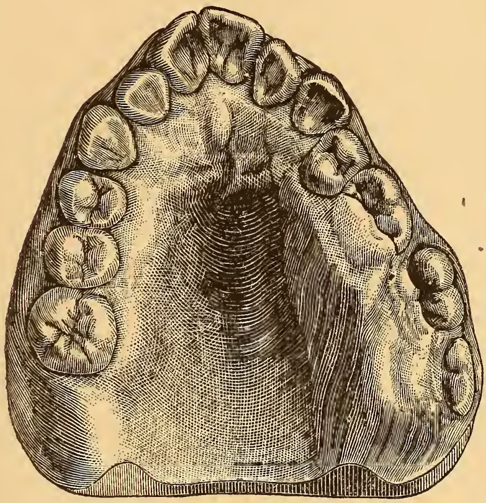
Fig. 7.



and are thus held in position. It will be observed that, in all of these cases, the enlargement seems to be associated with the inner plate of the alveolar process. My observation in these cases has been that with most of them the inner plate is the part of the alveolar process affected. The outer plate, although quite irregular from the arrangement of the teeth, is usually normal in thickness. This disparity in the two plates of the alveolar process may be accounted for from the fact that the inner plate of the alveolar process possesses a large blood-supply, the posterior or descending palatine arteries furnishing the ossific material. The author has observed a few cases where the hypertrophy has extended to and included the outer plate. When the outer plate becomes involved the alveolar process assumes a

very thick condition. Occasionally, hypertrophy will affect one side only or one distinct locality. Fig. 8 illustrates such a case. In this

FIG. 8.



case the enlargement is upon the left side and extends from the first bicuspid posterior to, and including, the maxillary tuberosity. Instead of the force being directed inward, as is generally the case, the process is forced outward and backward. This enlargement occurred previous to the development of the second and third molars. The alveolar process extends downward and occludes with the teeth upon the lower jaw, thus preventing the molars from erupting.

CHAPTER III.

CONSTITUTIONAL CAUSES.

Constitutional irregularities of the jaws and teeth are those deviations of the normal jaw that are developed with the osseous system and are not the result of accident. All constitutional irregularities are confined strictly to the jaws, though they may result in irregularities of the teeth.

They have their origin in inherited tendencies, direct or remote. resulting in arrested or excessive development, partial or entire, of the upper and lower maxillæ. Inherited peculiarities do not necessarily imply morbid conditions, though most cases of irregularities come under this head. Owing to this distinction they naturally group themselves under two heads:

A. *Anomalies of jaws in healthy individuals transmitted from generation to generation.*

B. *Anomalies of jaws that are the result of functional derangement.*

Like all scientific classifications these divisions cannot be kept absolutely distinct. The first class embraces what we term family and race peculiarities, which may have been the product of peculiarity of function. The monstrously developed angle of the lower jaw seen in some persons, the underhung jaw, and the highly developed upper maxilla and alveolar process of some Irish and Scotch families are examples of this class.

It would not be reasonable to class all deviations from the ideal type under irregularities; otherwise all peculiarities of race or nationality would have to be included.

A. ANOMALIES OF JAWS IN HEALTHY INDIVIDUALS TRANSMITTED FROM GENERATION TO GENERATION.

I. Arrest of Development of the Maxillary Bones due to Race —Crossing, Climate and Soil.*

It is a recorded fact that the early races possessed large jaws and regular teeth, and this fact has been verified by the examination of

*Read before the Indiana State Dental Society, June 25, 1888.

ancient skulls by Messrs. Cartwright and Coleman, and also by John R. Mummery, who has examined the skulls of three thousand modern uncivilized people between the years 1864 and 1870. Their conclusions were that irregularities of the teeth rarely, if ever, occurred among ancient races. More recent examinations by Dr. Nichols of the Chinese and Indians, during a stop of twelve years on the Pacific Coast and in the Rocky Mountains, show that irregularities do not prevail among members of the clannish tribes. Among the thousands of Chinese and Indians examined he failed to find a case of irregularity of the teeth.*

In 1881 I examined the mouths of more than three hundred Chinese without finding a case of irregularity in the shape of the jaws and teeth. The jaws of the Chinese are broad across the bicuspid and molar regions, and the teeth are very regular. The jaws of the African protrude anteriorly, and in this way the teeth find sufficient room. By examining the mouths of people living in new countries, where the population is made up of immigrants from every country we shall find some deformities of the jaws and teeth, which will increase with the growth of the country.

With these facts before us, what conclusions can we draw? Every nation has its peculiar race of people; the older the nation, the more clannish its people, the more fixed the type,—this type being molded after the peculiar characteristics and customs of the people, the climate and the topography of the country. The Chinese and Africans marry and intermarry among their own people, and the progeny are exact types of their ancestry for hundreds of years before; the race remaining excluded from others, and the habits and climate unchanged, so long will the characteristie type of a nation remain the same. The newer countries, as Germany, France, Norway, Sweden, as well as other countries, each have their peculiar type of people. Each individual is stamped with characteristics proclaiming the country of his birth. The size and shape of the head and skeleton, the contour and mold of the body, the manners, and all characteristic qualities are transmitted from generation to generation The jaws and teeth are alike included in the general transmission. But when members of the various nations emigrate

* Dr. Nichols doubtless refers to saddle and V-shaped jaws and protrusion of the upper and lower jaws.

and become citizens of a new country, the various influences surrounding them, of soil and climate and intermarriage, will produce in time a people as a whole totally lacking the distinctive features of any one race. America fitly expresses this condition: a land containing representatives of every country under the sun. The Indian and African, perhaps more than other races, illustrate this fact. Their progeny, the result of a union of Indian or Negro with Americans, do not possess the distinguishing features characteristic of either of the races, but are recognized as half-breeds, octoroons, etc., no longer showing the perfectly symmetrical jaws and teeth of the Indian, or the protruding maxilla of the Negro, but a smaller jaw, with the face sunken at the alæ of the nose. It may require generations to stamp out completely the predominating features of a race, but time has shown that a decidedly different tribe will result.

"The laws of inheritance," says Kingsley, "confirmed by common observation, show how constant is the mingling in the offspring of the traits of character and the peculiar features of two diverse races brought together in marriage. This mixture, without blending or harmonizing, is productive of deformity in character and physique. Thus, so far as the jaws and teeth are concerned, they may exist in each parent in perfect symmetry: in one parent the jaws and teeth are large; in the other parent both jaws and teeth are small; but each in its way is a normal development. If, now, the small jaw of one parent and the large teeth of the other appear in the offspring, deformity is sure to follow." Benedict declares * that abnormality of structure predisposes to disease, and among abnormalities of structure he mentions particularly pathological length and breadth of the face, pathological relation of the sutures, asymmetry and intercalaria.

The most convincing proof that abnormalities of the jaws are mostly due to race mixture is the fact that these abnormalities are not found in a pure race, *e. g.*, the Chinese and Negro races. By examining the figures of the dolichocephalous (Fig. 9), Sarmatic brachycephalous (Fig. 10), and the Turanic or extreme brachycephalous (Fig. 11) types, it will be seen at a glance how entirely different must be the single measurements, not only of the skull

* Kraniometrie und Kephalometrie. Wien, 1888.

generally, but of the face, and particularly the superior maxillary bones. These types represent, to a greater or less degree, the German, Slav and Finno-Magyar skulls of the present day, though it is probable that the differences are not so sharply drawn in living specimens.

Anthropologists agree that racial differences and peculiarities are shown more clearly by the skull as a whole than by any other portion of the skeleton. It is to be supposed, then, that in a mixture of two races with important cranial differences, an attempt by nature to mix the types, without the ability to blend them harmoniously, must result in an irregularity or abnormality. This argument is borne out in almost every respect by the sexual mixtures

Fig. 9.

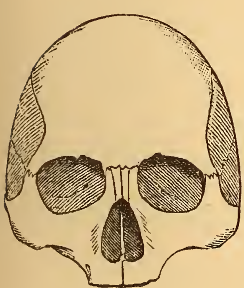


Fig. 10.

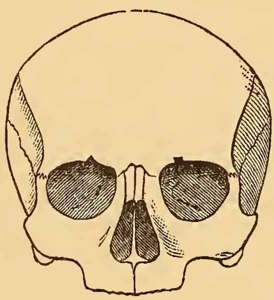
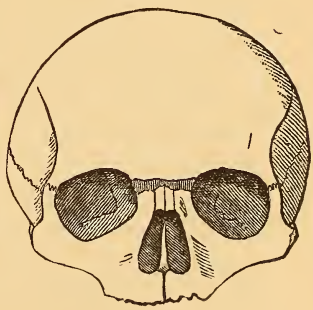


Fig. 11.



of plants and of the lower animals. In the case of plants, the abnormalities are shown in color, form and structure; in the case of edible plants, by form and structure chiefly, as, for example, the fertilization of the watermelon bloom by the pollen of the cucumber flower; in the case of animals, by variations in form and structure and temperament; and in man, on account of the predominance of the cerebral and nervous functions, and of the chief individual differences being found in the face, in variations as to form, to a certain extent, temperament and cranial structure. It is simply a matter of evolution, of change and reformation of type. But in civilized communities the law of survival of the fittest is practically annulled.

Let us suppose, for example, that a person with the form of cranium shown in Fig. 9 be married to one with the form seen in Fig. 11. It seems scarcely possible that there could be a perfectly har-

monious blending of the cranial differences in these types, even if both parents were in perfect health, and the offspring remain in perfect health throughout infancy, which may be said never to obtain in civilized communities. And what must be the result if nature attempt to combine what may be called the intellectual cranium of Fig. 9 with the animal strength of face and jaws of Fig. 11? Clearly, deformity, or at the least irregularity. Nature could never fit the superior maxilla of Fig. 11 into the face of Fig. 9. There is no incongruity involved in believing that she would attempt this. The law of inheritance—call it nature or what else—that insists upon perpetuating supernumerary digits and the like, would not stop at harmless peculiarities, as is shown by the distinct inheritance of disease, such as cancer, tuberculosis, heart-disease, etc. Nor is it too much to assert that neuroses, which are distinctly hereditable, are, in a large measure, due to abnormalities in the conformation of the cranium.

In investigating the causes giving rise to racial characteristic features and to individual deformities, we may gain much valuable information from the actions of the conditions of life, and the evolution of man from the embryonal to the adult state furnishes most interesting facts. "Simple arrest, a slight excess in the evolutive phenomena," says Quatrefages, "are, it appears to me, the cause of the principal differences which separate, and particularly the two extremes, the negro and the white." We need not fall back upon a theory of reversion of type. The human fœtus furnishes all the elements of a human evolution theory.

Few will deny that what is true of the whole organism is equally true of its different parts, organs, functions and energies, and that in the formation of a new being the action of heredity is divided into as many cases as there are characters to be transmitted. There is a tendency on the part of each parent to reproduce itself in the child, and consequently there is a constant struggle between the two natures in the morphological growth of the child. The more dissimilar the parents, the greater the struggle, and the more certain the predominance of leading characteristics, and the greater the tendency to morphological abnormalities,—arrest or excess. The outcome of this struggle, assuming inequality of action on account of one parent being stronger, is a number of single combats, in which one or the other of the parents is vanquished.

In crossing between different races, says Quatrefages, the half-breeds possess the characters that in each of them predominate over the corresponding characters of the other.*

While the general relations of length and breadth in the crania of human races are apparent from birth, the studies of Gratiolet go to show that dolichocephaly is due to a relative development of bones, which varies with age. In the infant it is essentially occipital, in the child temporal, and in the adult man frontal. Unfortunately, in this respect, anthropologists have studied the bones of the face less closely than those of the skull. In a general way faces may be divided into euryopsal and dolichopsal (broad and long). For reasons that are apparent, the inferior limit of the face should be the alveolar border of the superior maxilla, middle line, while the upper limit is the point sus-nasal,—the fronto-nasal suture. The line connecting these points is always less than the bizygomatic breadth. The product of the length of the face multiplied by 100 and divided by the breadth is known as the facial index. Broca show that this index is greatest in the embryo, less in a perfect fœtus, and constantly diminishes as the body approaches its final and definite state; and from this he concludes that the variations seen in the same race may be often referred to an arrest of development, or rather to an arrest of evolution. Quatrefages regards this as a very correct explanation of one of the distinctive features that most clearly distinguishes the black race. It is to be remarked that in all races the nasal and orbital indices of the woman are greater than those of the man, and consequently the woman thus preserves a certain infantile character.

Now, we know that it is the superior maxillary prognathism of the negro that so clearly distinguishes the negro's face from the orthognathous face of the white; and this variety of prognathism arises from that portion of the superior maxillary bone situated below the nose, and comprising the alveoli of the incisors and cuspids. But the degree of prognathism in the individuals of any one race is not constant; there are oscillations of characters that are everywhere met with in races not subject to selection with any special aim. The prognathism of the negro is evidently an excess of development, since it increases with the age of the individual.

* It must be remembered that every mixed race, when uniform and settled, has been able to play the part of a primary race in fresh crossings.

More or less essential characters are found in the zygomatic arches, the malar bones, and the superior and inferior maxillæ; and in reference to a given race, Quatrefages asserts that they acquire a value superior to that which they have elsewhere. Such is the slight elevation of the palatine vault in the Lapps.

The existence of a cessation of evolution is again proved by the parietal angle, which may be negative in the adult, and is then nothing more or less than a persistent fœtal or infantile characteristic; for this angle is negative in the fœtus and infant in all races. The shape and size of the supra-maxillæ therefore depend to a great extent upon the shape and size of the cranium.

There are certain characteristics, long supposed to be purely racial, that are now definitely known to depend upon climate and soil, particularly the former. Such are the statopygia of the Bojesman and Houzouana races, which were thought to be peculiar to these races until certain women of the Boers, of undoubted Dutch descent, were affected by them. On the other hand the fat-tailed sheep of central Asia lost the appendages when the Russians removed them from their native country.

Climate and soil and the conditions of life may modify the bony parts to an important extent. Blumenbach showed that there is more difference between the head of the domestic pig and that of the wild boar than between those of the white and negro races. In this connection we are at once reminded of the marked difference between the heads and the skeletons of the bull-dog, greyhound and spaniel for example. The *niata* cattle of Buenos Ayres and La Plata exhibit characteristics of their own, and not unlike those distinguishing the bull-dog from other dogs. "All the forms are shortened and thickened, the head in particular seeming to have experienced a general movement of concentration. The inferior maxillary bone, although itself shortened, so far exceeds the superior in length that the animal is unable to browse the trees. The cranium is as much deformed as the face; not only are the forms of the bones modified, but also their relations, not one of which, according to Professor Owen, has been strictly observed." There is a perfectly established race, but it, as are all American cattle, is descended from European stock. The wool of sheep is modified to a marked extent by change of climate and soil; and an expert wool man in Chicago asserts that he can tell by the feel of the wool from what part of the country and particular State it has come.

The effect of change of climate is seen also in fruits of the soil taken from one climate to another. This was first seen in the case of the peach, and later in the cases of wheat and tobacco. Tobacco-seed brought from North Carolina to Wisconsin and planted soon produces an entirely different-looking plant and different grade of the tobacco from the parent stock—different in color and properties.

Climate cannot cause these changes alone, however; in the case of plants it is undoubtedly a large factor,—perhaps larger than in the cases of the lower animals and men. The structure, appearance, color, and other peculiarities of plants are influenced by soil, from which they obtain their food directly, and by breeding. The effect of close breeding upon plants and fruits, the difference in the results when plants are propagated by seeds or by buds and shoots or slips, are too well known to require discussion or extended mention.

In the case of the difference in the texture of the wool of sheep grazed in different localities, it seems that, even with the same family of sheep, food must play as large a part in giving the peculiar texture to the wool as climate. In the case of horses of La Camargue, sheltering and careful feeding of the mares have the effect of raising the height of this breed of horses. As regards the human family, Durand (de Gros), in confirmation of an observation made by Lartet, showed that in the Aveyron the populations of the limestone cantons are sensibly taller than those of the granite or schistose cantons; and Dr. Albespy stated that liming lands in the non-calcareous portions of this district has raised the height by two, three, or even four cm. on the lands where this practice has existed for the longest time (Quatrefages). This same effect of liming lands, I am told by an army officer born in Maryland, was observed in one of the districts of Maryland some years ago.

That changes of climate and soil do modify races and nations to an important extent is shown by the Anglo-American, the Yankee, who no longer resembles his ancestors. Andrew Murray, in endeavoring to account for the formation of animal races, said that he could not do better than appeal to the condition of mankind in the United States. At the second generation of the English Creole in America, says Quatrefages, his features present alterations that approximate him to the native races. In the face the temporal fossæ are pronounced, the cheek-bones become prominent, the orbi-

tal cavities become hollow, and the lower jaw massive. The negro has undergone remarkable changes since being brought into the United States, the most remarkable being that his physiognomy has altered. "In the space of one hundred and fifty years," says Reclus, "they have passed a good fourth of the distance that separates them from the whites, so far as external appearance goes." "We shall have to recognize," says Quatrefages, "that in the United States a sub-negro race has been formed, derived from the important race."

In this connection it is a curious and interesting fact that the teeth of Scandinavians decay almost immediately after arrival in this country, and this is doubtless due to change of climate, soil and food. Every race being a resultant whose components are partly the species itself, partly the sum of the modifying agencies that have produced the deviation from the type, nothing is more in accordance with natural laws than that still further modifying causes, differing from any that a race has known before, should modify types to a very marked degree. The race will retain some of the former characteristics, but it will at the same time acquire new characteristics Conditions of life and heredity, then, are both modifying agents and agents of stabilization, and in either case, says Quatrefages, their result is to harmonize organisms with the conditions of their existence; and heredity, which is essentially a preserving agent, becomes an agent of variation when it transmits and accumulates the modifying actions of the conditions of life. Those who are interested in this subject are advised to read "Animals and Plants under Domestication," by Darwin.

II. Arrest of Development and Excessive Growth of the Maxillary Bones.

Excessive growth of bone-tissue is frequently seen in connection with the superior and inferior maxillæ. It may be a natural growth or the result of disease. If the large jaw is naturally so, it will develop gradually, and will not attain its full size before the age of from twenty-six to thirty-six years. The size of the jaw corresponds quite closely to the size of the head, other things being equal, the large head containing the large jaw. We occasionally find, however, a very small jaw in a very large head, and *vice versa*. The upper jaw is more subject to morbid influences than the lower jaw,

because of its development in connection with the bones of the head. The lower jaw rarely exceeds the average size. It is possible, however, by constant use, to increase the size of the jaws, as is shown in acrobats and those who use their jaws in performing various feats, like "the man with the iron jaw." The skulls of tobacco-chewers, singers, public speakers, and the early races who lived upon corn, shells, roots, etc., show that the jaws may be increased, or at least favored in their development, in size, by use. If the bones at the base of the skull are slow in ossifying, as is sometimes the case, the maxillary bone will frequently develop to an unusually large size.

Enlargement of the jaw-bones is an occasional cause of dental irregularities. It may occur in either jaw, but generally in the upper, and is due to hypertrophy on the one hand, or hyperplasia upon the other; also to osteitis, periostitis, continued irritation drawing blood to the part, and, in some cases, to disease of the antrum and nasal fossæ, producing the same effect. Disease of the antrum may cause either periosteal or osteal enlargements. Hereditary syphilis has an especial predilection for the bones, particularly at the junction of epiphysis and diaphysis. The growth of the teeth does not proportionately increase, and the consequent disproportion between the teeth and jaws necessarily produces a deformity. The forms of irregularities of the teeth that co-exist with crowded arches are not seen in enlarged jaws. Rachitis in children, whether due to syphilis or not, causes hypertrophy and hyperplasia of the jaws. The hypertrophy and hyperplasia may be localized in some portion of the jaw, causing it to be unevenly developed.

The last, but not least, of the causes of arrested development of the maxillary bones which I shall mention is that due to constitutional diseases and the eruptive fevers. Debilitating acute diseases (fevers, the exanthemata, etc.) in children are sometimes followed by sudden overgrowth of bone, which is quite noticeable. This process affecting the jaw may account for certain proportions of those cases of measles and pneumonia which are followed by dental irregularities and maxillary deformities. In some cases, however, the process is a low grade of inflammation, which is followed by atrophy of the jaw instead of hypertrophy or hyperplasia. The special predilection of these processes for the superior maxilla is on account of its liberal blood and lymphatic supply, and the contiguity

of such cavities as the antrum and nasal fossæ, which, in many cases, contribute their quota of irritation.

The question of diathesis enters largely into the etiology of maxillary and dental deformities. The physical characteristics of strumous children demonstrate this fact quite forcibly. The description of this diathesis given by Fothergill is decidedly apt in this connection: "This diathesis has an imperfectly developed osseous system as one of its characteristics. The bones are small, the shafts slender, the epiphyses enlarged; the hands are often unshapely from this osseous defect; the thorax is small; the forehead is high and prominent; the jaw is small, and the teeth crowded and carious." Persons of a nervous diathesis have small jaws, but not in disproportion to the rest of the osseous system. The jaws may be relatively small, however, because the teeth frequently do not partake of the symmetrical smallness of the other bony structures. Constitutional diseases, such as the exanthemata, syphilis and phthisis, may affect the jaws in common with the other bony structures, and as the teeth do not vary much in size in different subjects, a relatively small jaw results in such cases. Dr. Florence Hunt, of the Cook County Insane Asylum, informs me that the majority of the Swedish and Norwegian patients are affected with scrofula and other constitutional diseases, and that post-mortems reveal soft and undeveloped epiphyses not unlike cartilages.

The first effect of irritation of bone in any situation is a determination of blood-supply with its attendant increase of nutritive material; soon proliferation of young connective tissue begins from the osteophytes and from leucocytes brought by the blood. The young connective tissue soon appropriates the necessary ossific material from the blood, and, after passing through the fixed connective-tissue period of its existence, becomes bone-cells and fibres. In some cases of malnutrition the period of ossification does not supervene, but the soft and spongy bone becomes atrophied, through the contraction and hardening of the connective-tissue stroma formed in the pathological process of perverted bone-building. In some cases there occurs merely thickening of the pre-existing bone-structure, the new connective tissue being absorbed. This constitutes osteoplasia or true hyperplasia of bone.

Where hypertrophy occurs, it may assume one of two forms, viz., an ivory-like hardness, or a spongy condition, indicating the exist-

ence of chronic osteitis. When these processes are localized we have one or the other varieties of osteoma or osteoid tumor. These various processes produce a variety of deformities dependent upon their extent and location.

As has been previously stated, the irregularities of the teeth caused from a crowded condition do not exist in enlarged jaws. If the growth of the jaw is uniform throughout, spaces will exist between the teeth as far back as the first permanent molars, differing in width in proportion to the relative positions of the teeth and articulations of the jaws. If the growth of the jaws is not uniform in the natural development, or is the result of disease, the anterior teeth will be influenced in the direction of the growth. In a majority of cases the molars of one jaw will antagonize uniformly with those of the other jaw. The first permanent molars form a fixed point of resistance in the posterior part of the mouth upon which the jaws rest, thus keeping the teeth in a fixed position, the second and third molars coming later and crowding against them. The only exceptions to this rule are cases where the molars have been extracted too early, and where there are tumors of the jaws. As illustrative of the interesting character of some of these conditions described, I take the liberty to present a few cases which have come under my notice.

Case I. Arrest of development. Girl, age ten. Consumption on father's side; cancer on mother's side. Child scrofulous, with small bones, especially the maxillary bones, which are unusually small. The teeth of both jaws (permanent first molars and incisors, temporary cuspids and molars) are in a very crowded condition. The teeth are normal in size. With such unusually small jaws, and the teeth at this age being very crowded, I shall watch this case with great interest. I shall expect to find marked V- or saddle-shaped arches. I have observed similar results in like cases.

Case II. Arrest of development. Girl, age sixteen. When quite young had a severe attack of scarlet fever, and the arrest of the development of the bony framework resulted. The jaws are unusually small, and the teeth are crowded to such an extent that the cuspids remain outside the arch.

Case III. Enlargement of the superior maxilla. George W., age fourteen. This boy was sent to me for an opinion in regard to his teeth. Upon examination I found the teeth of the normal size.

Spaces existed between all the teeth as far back as the first permanent molars. The bicuspids were not fully developed, but were through the gum sufficiently to notice their position in connection with the other teeth. The spaces were not uniform, those between the incisors being the largest. The widest space was between the central incisors; the incisors of the lower jaw coming in contact with the mucous membrane of the mouth posterior to the superior incisors.

Case IV. Hypertrophy of the jaw. J. B., age nineteen. This patient came under my treatment in June, 1887. When fourteen years of age he received a blow upon the side the jaw. He is of a scrofulous nature. The blow produced a low form of inflammation, and hypertrophy of the bone supervened. The teeth of that side of the jaw were carried laterally, and spaces existed between the bicuspids and molars.

Case V. Antrum disease. Boy, age seven. German descent; born in this country; scrofulous. Quite a deformity was noticed upon the left side of the face, produced by the bulging of the antral wall. Hypertrophy of the alveolar process also existed. The temporary teeth on the left side of the upper jaw extended beyond those of the lower jaw. Upon opening into the antrum a thick, ropy fluid exuded. After three months' treatment no improvement has been noticed.

III. Development of the Inferior Maxilla by Exercise.

The superior maxilla is influenced to a greater degree by the various causes of jaw-deformities than the inferior maxilla. The bones of the upper jaw are in direct contact with the other bones of the body, while the lower jaw, unlike all the other bones, develops independently, and is only attached at its remote extremities by articulation. The growth of the body of the bone is free to develop or to remain in a dwarfed condition, depending wholly upon its blood-supply for its nourishment. The superior maxilla, as has been stated in a previous paper, shows indications of gradually diminishing in size. The inferior maxilla, although under the same influences, has a powerful factor to aid its preservation, viz., motion and exercise. On this account the question presents itself, as to what extent certain properties of the jaws, influenced by habit (use), may be transmitted. The tissues of the body especially those of the osseous and musclar systems, possess a certain degree of plasticity, by

which they are enabled to change their weight or shape. This quality depends upon the use of muscles and bones. Among vertebrates we find a close relation between the muscles and the bones upon which they are inserted. The union is made up of tendons, which are prolongations of the muscles to the periosteum, and the periosteum is attached to the bones. Powerful muscles and large bones are always associated, exercise developing them both simultaneously. As outward changes occur in the life of human beings or animals, adjustment to environment tends to alter the physical charcteristics. These changes often occur through such gradual modifications that from one generation to another but little marked difference is noticed, but the structure, in the course of a number of generations, will so change that a new species will be developed. Any animal domesticated from a wild life shows this change, and among human beings the negro imported from Africa will, after several generations have a less prominent jaw-bone, and the frontal bone will become more prominent.* The changes, although existing in the white races, after intermarriage with other nations, are not so pronounced and rapid as in the negro cross-breed, but are gradually occurring. No part of the body demonstrates these changes so forcibly as the superior or inferior maxilla. The extremities must be measured and weighed to compare the two halves of the body.

The accustomed eye can at a glance compare the jaws and teeth and observe the slightest deviation. Whatever views are held regarding the origin of man, it cannot be denied that the human jaws of the earlier races resembled those of the anthropoid ape, whose upper and lower maxillæ protruded and were uniform. Observation will show that the changes in the shape of head and jaws are not confined to one race nor to past generations, but are continually progressing. These changes are not uniform in the two jaws. The superior maxilla is a fixed bone, and the inaction from lack of exercise gradually affects and diminishes the volume of bone-tissue from one generation to another.

The inferior jaw, on the other hand, is constantly in motion, which causes a flow of blood to the part, and the activity of nutrition in the muscles and bone increases their size and strength. This increase

* In some instances, the laws of hereditary and sexual selection necessarily co-operate with environment in producing this change.

of the bone by exercise of the part has been alluded to by C. Harting in reports of examinations made. He says that "the bones of the right upper limb are generally larger than those of the left." This increase in size was not confined to one bone, but to all the bones of the right limb. The weight of the right arm without the hand is to the weight of the left arm without the hand as 106.2 : 100, a difference of about six per cent., which would indicate not only an increase in the volume of muscle, but in the weight of the bone. Exercise of the inferior maxilla, which has always existed, has developed the jaw, while the superior maxilla has dwarfed from non-exercise. The contour and expression of the face depend, to a great extent, upon the shape of the inferior maxilla. Frequently this bone will exhibit peculiar family characteristics in early life. Oftener, family resemblances are not established until the individual has attained his full growth, from the thirtieth to the fortieth year. Hereditary peculiarities may exist at birth, like the transmission of features, or color of eyes or hair but family likenesses may not appear until middle life, like the contour of the face, shape of the nose, or shape or size of the inferior maxilla. Such being the case, it may be assumed that motion and exercise are the prime factors in assisting the development of the inferior maxilla.

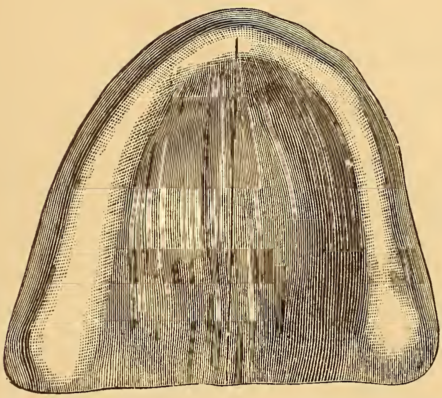
IV. Asymmetry of the Lateral Halves of the Maxillary Bones.

Asymmetry of the lateral halves of the maxillary bones exists in the present era of the human race, and, like other irregularities and imperfections in the structure of the body, it prevails to a greater extent among the idiotic, the deaf and dumb, and among the offspring of mixed races, than in clannish tribes or nations Each lateral half of the body develops independently of the other. The jaws, like other members, are influenced by the independent growth of the two halves, so that each has its own peculiarities. Asymmetry, therefore, is caused from an inharmonious lateral development of the parts. The superior and inferior maxillary bones, growing independently of each other, may be subjected to peculiar characteristics of environment, so that the result of their development may be asymmetry of the jaws. Extreme asymmetry of the lateral halves of the human body is frequently observed, and, as some of the recorded cases are of special interest, I will mention a few of them.

These cases are so marked that they are noticeable by the most casual observer. In measuring the lateral halves of the body by the system of measurement of criminals and convicts introduced some years ago by M. Bertillon, we shall find that the halves do not harmonize in a single instance. These differences are not altogether inherited or natural, but have been acquired, to a certain extent, by exercise of the part. Marked illustrations of development by exercise are seen in the blacksmith, whose right arm is larger and will weigh heavier than the left. The peddler who carries a pack has the side most in use developed more than the other.

If exact measurements of the maxillary bones could be made, a lack of harmany in the lateral halves would be observed in weight, shape and size. The difference is generally not sufficient to affect

FIG. 12.



the contour of the face, but causes faulty articulation to the teeth upon that side of the face. The deformities of either lateral side of the superior maxilla are not necessarily like those of the inferior. Excessive growth or arrested development appear upon both sides of the jaws, sometimes on the right and again upon the left. Examinations of these deformities can be made only when the second teeth have been extracted and the alveolar process has been absorbed.

Fig. 12 shows the superior maxilla after absorption has taken place. If a line be drawn through the jaw at the median line, it will be seen that the left half is fully developed, while the right half is contracted at the bicuspid region. The following statistics show the deformities in the contour of jaws modeled by Dr. L. P

Haskell, of Chicago, who has a large collection of models, and who kindly assisted me in their examination:

UPPER JAW.

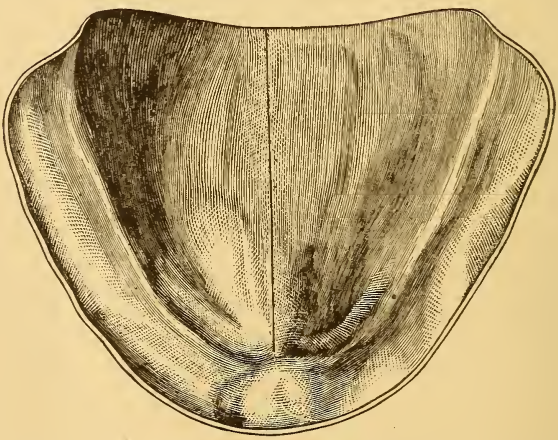
Total No. examined	298
Total No. normal	137
Total No. abnormal, right side	73
Total No. abnormal, left side	88

Fig. 13 illustrates the inferior maxilla after the teeth have been extracted and absorption of the alveolar process has taken place. By drawing a line through the centre of the lower jaw at the median line, a wider space may be seen to exist between the line and the left side than on the other side.

LOWER JAW.

Total No. examined	154
Total No. normal	54
Total No. abnormal, right side	12
Total No. abnormal, left side	88

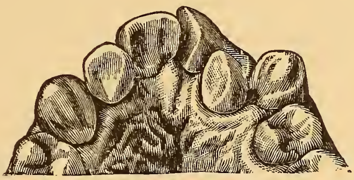
FIG. 13.



In the study of irregularities of the teeth during the past eight or ten years, I have observed that, although no two cases of irregularities of the teeth are exactly alike, there is a general similarity of shape and outline of alveolar process and jaws, owing to similar environments during eruption of the teeth. Upon the hypothesis that the two halves of the superior maxilla are developed in pro-

portion to the excess of food masticated on one side or the other, depending upon right and left-handedness of the individual, we suppose that the case illustrated is that of a left-handed person, as the left side of the jaw is larger. But it appears that this side is normal in size and the right is deficient in development. By examining carefully the contour of patients' teeth, we shall observe that but few arches are uniform. While one side may be normal the other

Fig. 14.



will be depressed. Fig. 14 shows such a deformity. This cut is taken from the model of an extreme case of irregularly-shaped jaw. It represents a perfect semi V-shaped arch. (I find in my collection of models thirty-eight of this variety of deformity, twenty-four of which are on the right side and fourteen on the left.) Most of these irregularities are not quite as depressed at the cuspid region as the cut indicates. No two are exactly alike as regards the position of the teeth, and yet the similarity is so complete that a non-professional man would immediately take notice of it. The asymmetry of the jaw illustrated in Fig. 12 is probably caused by the peculiar arrangement of the permanent teeth in the arch, since the deformity is not apparent during the first set of teeth, the alveolar process and maxillary bones being molded into this peculiar shape thereby. Since but few people are left-handed, this percentage is very large, showing twenty-four out of thirty-eight cases with deficiencies on the right side, when we might look for normal or excessive development on that side. The cause of this irregularity I believe to be local in its origin,—viz., too early extraction of the temporary teeth upon the affected side: thus showing that one side is as liable to be affected as the other. The mechanism of this irregularity will be found under the head of local causes.

The asymmetry upon the lower jaw may be traced to two causes: 1st. The full number of teeth retained upon the long side. If the third molars should develop on one side only, the jaws on that side

would expand by the crowded condition of the teeth and extend farther from the median line than otherwise. The loss of the third molars by extraction or non-development would prevent the other side from increasing to the natural size. 2d. The relation of the upper teeth to the lower teeth. The articulation of the inferior maxilla with the cranium is so remote, and the contour of the two bones so unlike, that uniformity of bone-structure cannot be looked for. When we consider the complexity of the development of bone-tissues, first of the maxillary bone, then of the alveolar process, and lastly of the two sets of teeth, it is a wonder that harmony ever prevails.

BIBLIOGRAPHY.

(1) Harting, P. "Sur une Asymétrie du Squelette Humain se Transmettant Héréditairement." Arch. Néerl. d. Sc. Exactes, etc., La Haye, 1869, iv. 44–54.

(2). Foucher. "Excessive Development of Left Arm and Leg." Bull. Soc. Anat. de Paris, 1850, xxv. 108;

(3) Hayden. "Congenital Atrophy, or Arrest of Development of the Right Upper Extremity." Dublin J. M. Sc , 1878, lxv. 521.

(4) Chassaignac. "Hypertrophie Congénitale des Deux Membres Droits, Taches Sanguines Multiples, Varices, etc." Bull. Soc. de Chir. de Paris, 1857–58, viii. 452.

(5) Hulke, J. W. "A Case of Complete Absence of both the Upper Limbs and Faulty Development of Right Lower Limb." Med. Chir. Jr., London, 1877, lx. 65–69.

(6) Smith, G. H. "Malformation of both Extremities on the Right Side.', Lancet, Lond., 1841–42, i. 358.

(7) Guerin, J. J. "An Abnormality." (Left side undeveloped.) Canada Med. & S. J., Montreal, 1881–82, x. 655.

(8) Birkett, J. "Case in which the Right Leg has Grown Longer than the Left, and the Right Patella has become Hypertrophied." Trans. Path. Soc. Lond., 1867, xviii. 284-287.

(9) Lonsdale, E. F. "Case of Curious Deformity of the Lower Extremity from Arrest of Development; Deformity of the Upper Extremity also." Ibid., 1851–52, iii. 464–468.

(10) Caizergues, R. "Arrêt de Développement du Côté Gauche," etc. Montpellier Médical, 1879, xliii. 248–251.

(11) Broca, P. "Inégalité Congénitale des Deux Moitiés du Corps; Singulières Conséquences physiologique." J. de la Phys. de l'Homme, Paris, 1859, ii. 70–74.

(12) Burlet, P. "Observation sur une Inegalité Congénitale des Deux Moitiés du Corps; Hypertrophie Congénitale de Tout le Côté Droit." Mem. Soc. d. Sc. Méd. de Lyon, 1862, i. 225–230.

(13) Charcot et Turner. "Exemple d'Atrophie Cérébrale, avec Atrophie et Déformations dans une Moitié du Corps." Comptes Rendu, Soc. de Biologie (1852), Paris, 1853, iv. p. 191.

(14) Devogues. "Prédominance du Développement du Côté Droit sur le Côté Gauche," etc. Bull. Soc. Anat. de Paris, 1856, xxxi. 510–518.

(15) Howden, J. C. "A Case of Atrophy of Right Hemisphere of Cerebrum and Left Side of Cerebellum, with Atrophy of the Left Side of the Body." J. Anat. & Phys., Lond., 1875, ix. 288–296.

(16) Hubbard, J. C. "A Case of Asymmetry of the Two Halves of the Body." Ibid., 1871, N. S., lxi. 289.

(17) Lorinser, F. "Uber den Einfluss der Ungleichseitigen Körperentwickelung auf die Wirbelsäule." Allg. Wien. med. Ztg., 1872, xvii. 637.

(18) Perroud. "Observation d'une Inégalité des Deux Moitiés du Corps; Crises Épileptiformes avec Diminution de l'Intelligence," etc. (Mém. Soc. de Méd. de Lyon, 1862, i. 332–334.)

(19) Du Plessis. "Nouveau Cas d'Asymétrie Unilateral Congénitale de Toute la Moitié Gauche du Corps, chez une Jeune Fille de 16 Ans." Bull. Soc. de la Suisse Rom., Lausanne, 1871, v. 24, 31.

(20) Taylor, T. "A Case of Unilateral Atrophy," etc. Tr. Clin. Soc., Lond., 1878, xi. 118-123.

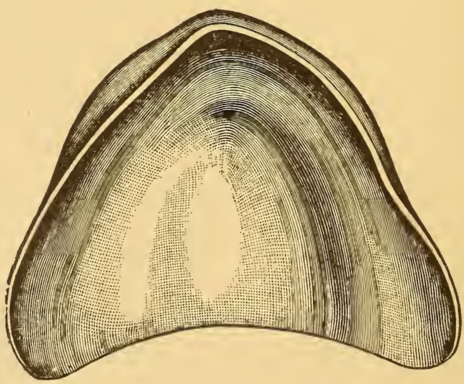
V.—Asymmetry of the Maxillary Bones.

*Haskell's Deformity.**—When we examine models of the superior maxilla after absorption of the alveolar process has taken place, we observe that in the cuspid and bicuspid region, high above the alveolar border, a marked depression exists on either side. Fig. 15 shows a base-plate which has been formed over such a model. The plate is more depressed at the left than at the right side. This peculiar deformity is familiar to the operator who arranges teeth and waxes up plates for the purpose of restoring the contour of the face. Upon closer inspection of the model it will be seen that there is an asymmetry of the lateral halves of the maxillary bones. With Dr. Haskell's assistance I have examined 298 models, finding 268 out of the number with marked depression on the left side, and 24 with the depression on the right side, and only six cases showed both sides to be alike. It is remarkable that so large a proportion of the cases of this deformity should be found existing on the left side.

* I have named this deformity "Haskell's Deformity," for the reason that Dr. Haskell called the attention of the profession to this peculiar condition of the maxillary bone years ago, personally and through the journals, and says he has found but one dentist who had observed it.

Dr. Haskell says, "For many years I have observed a marked difference between the right and left sides of models of both the upper and lower jaws, but more especially noticeable in the upper jaw. It is not so apparent upon a casual glance at the model, for it is not so much in the alveolar process as in the maxillary bones. But a plate swaged upon a model from an impression taken high over the region of the cuspids (as ought always to be done) shows at once the depression of the left side, which occurs, to a greater or less extent, in 95 per cent. of cases. The difference becomes apparent in arranging artificial teeth. Every dentist of experience must have observed that greater length of teeth and gums is required upon the left side than upon the right How often it is seen that the left side of the lip rises higher, in talking and laughing, than the right side. The difference in the two sides of the lower jaw does

FIG. 15.



not occur as often, but is apparent in the divergence of the left side from a line drawn through the centre of the model, so that the posterior teeth on that side must be set farther in upon the plate."

Dr. Haskell has, during the past twelve years, frequently called my attention to this peculiar deformity of the jaw. My own observation of models and patients has also indicated the probability that the majority of deformities of this nature exist on the left side. The following theory for this deformity suggests itself as worthy of our consideration: Man, like some other members of the animal kingdom, moves the lower jaw from right to left in mastication. The constant friction of the lower teeth against the upper carries

the superior arch with the alveolar process towards the left. By pressing the index finger over the cuspid and bicuspid roots, above the alveolar process, we shall find that the majority of mouths contain teeth with their roots standing out more prominently upon the right side than upon the left side. The right superior dental arch, like the arch of a bridge, resists such inward force because of the lateral contact of its teeth. On the contrary, the left superior dental arch may thus be carried slightly outward. The limited lateral motion during occlusion prevents the teeth and alveolar process from being carried farther. The cuspid tooth may be prevented from being carried in as far as it otherwise would be owing to the lateral motion of the lower jaw to the left. The alveolar process is thus carried beyond the border of the maxillary bones. After the teeth have been removed, absorption of the alveolar process occurs, leaving only the alveolar ridge. The ridge then overhangs the maxillary bone, thus producing a depression upon the left side. This is the reason that, in arranging artificial dentures in many cases, the teeth are carried over the alveolar border farther than upon the right side to obtain proper articulation with the natural teeth upon the lower jaw.

On examining the model upon which the base-plate was formed, it will be seen that both the right and left alveolar borders are symmetrical. The alveolar border in most cases indicates the contour of the teeth when in position.

VI. Asymmetry in the Rami.

A case recently seen with Dr. G. Frank Lydston, of this city, is a marked illustration of congenital maxillary asymmetry. The man is thirty years of age. The inferior maxillary is small and the chin pointed and narrow. There is a difference of one-half an inch in the length of the rami, the left rami being the shortest. The difference is sufficient, when the face is smoothly shaven, to produce a noticeable deformity. The teeth are irregular in both jaws, the irregularity, however, being most marked in the superior jaw. The cranium partakes of the asymmetry, and the frontal suture is plainly marked. Numerous irregularities of the surface of the skull are observable. The larynx is displaced at least one-half an inch from the median line toward the left side. There is no history of injury, and a point of interest in this case is the fact that the asymmetrical

and small jaw is a family characteristic, and has been noticed for several generations. The jaw, in this case, resembles the father's, while the arrangement of the teeth is similar to that of the mother. The upper portion of the body appears to have been developed in two lateral halves, and when brought together the left side of the body was higher than the right side. The cranium and maxillary bones show this deformity quite conspicuously. The teeth, which are comparatively sound, are all present. The left superior maxilla is considerably higher than the right. Occlusion is perfect, thus compensating for the short left ramus.

VII. Asymmetry in the Body and Improper Occlusion.

The daughter of an old patient of mine came to me for treatment September 14, 1888. She was about seventeen years old, and had quite a prominence upon the right side of the lower jaw, and another, although not so marked, upon the left upper jaw. The left corner of the mouth was nearly one-quarter of an inch higher than the right. The face was full and had a peculiar expression, owing to the mouth and jaw being at an angle when closed. Upon examination, I found the left superior maxilla one-quarter of an inch higher than the right side. The alveolar process and teeth shared the same irregularity, thus placing the line of the teeth on the same plane as the lips. The body of the inferior maxilla, from the symphysis to the angle, seemed to be longer upon the left side than upon the right. When the jaw closed, the median line of the lower jaw was half an inch to the right of the upper. The lingual cusps of the biscuspids and molars on the right side of the lower jaw occluded with the buccal cusps of the bicuspids and molars of the upper, and *vice versa* upon the left side.

The two cases just described are interesting from the fact that while the causes and the external appearances of the face are entirely different, the alveolar processes and the occluding surfaces of the teeth are on the same angle, the inclination being in the same direction. This deformity is frequently found in the mouths of patients over forty years of age, where all the teeth have been removed upon the side of one jaw and upon the opposite side of the other, the alveolar processes containing the teeth elongating upon the side where there is no antagonism, and throwing the occluding line of the teeth out of position at an angle similar to that above described.

By examining the mouths of 1977 idiots there were found to be 159 with protrusion of the superior maxilla, and 92 with protrusion of the inferior maxilla. These deformities do not exist to such an extent among healthy individuals. This inharmonious development of the maxillary bones may extend from the articulation to the incisor teeth. Such deformities are rarely found in connection with the first set of teeth. When the superior maxilla protrudes during the period of the temporary teeth, it is usually caused by thumb-sucking. Protrusion of the inferior maxilla is the result of the abnormal development of the rami or body of the jaw. As these abnormal conditions usually correct themselves when the temporary teeth are shed, they consequently receive little attention. But where these deformities arise during second dentition the jaws are determined towards false positions, thus endangering the beauty of the face. We occasionally see excessive growth or hypertrophy of the superior maxilla. When the teeth are normal in size they appear small in proportion to the abnormally large jaw. They are carried forward with the alveolar process to such a degree that the teeth and lips may protrude. In such cases it appears as if the body or rami of the inferior maxilla were much shorter than is natural, but by close inspection we shall see that the inferior maxilla is normal and quite a space exists between the superior and inferior central incisors. Protrusion of the superior maxilla is a common defect; it is accompanied by a depression of the face at the root and alæ of the nose, and a protrusion of the anterior alveolar process and upper lip. If the maxillary bones, as well as the alveolar process, are enlarged, the teeth will stand perpendicularly with the alveolar process. If the superior maxillary bones are small, the teeth will protrude from the perpendicular to an angle of 45°. Such a case is illustrated by Fig. 64, page 131, Kingsley's "Oral Deformities," and in Fig. 130, page 145, Talbot's "Irregularities of the Teeth;" this is a deformity frequently met with in practice. A common cause of protrusion of the superior maxilla is illustrated in Fig. 16.* The teeth in the upper jaw are fully erupted, but are directed downward and forward. The teeth in the lower jaw are in their proper position. It will be observed that the rami of the jaw are inharmoniously developed, the rami being so short when the jaws close, that the occlusion throws the superior teeth and alveolar process forward. In this case the

* These cuts represent cases in my practice.

alveolar process is quite thin, because the arch is high and the teeth having long slender roots are easily carried forward. The inferior maxilla is large, the structure dense and hard, and the teeth firmly fixed in position in the jaw. When occlusion takes place, the weaker structure (the superior maxilla) is carried forward by the stronger (the lower maxilla), thus forcing the alveolar process forward. The shortness of the rami of the inferior maxilla causing improper closing of the jaws is a feature strongly impressed upon the dentist who undertakes to insert artificial dentures. The tendency of the lower jaw to force an upper denture out of the mouth, by striking the teeth at an angle instead of perpendicularly, is a marked

Fig. 16.

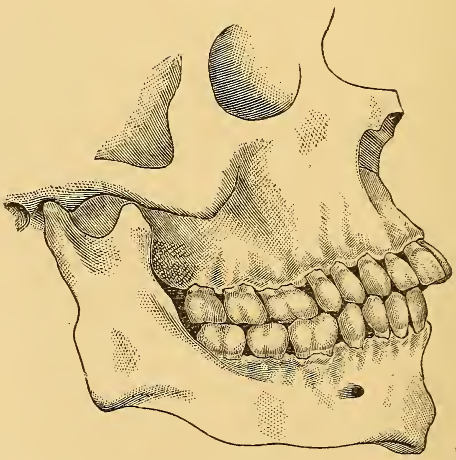


illustration of the inharmonious development of the jaws. The same difficulty is frequently experienced with the partial lower plate when it presses against the anterior teeth and alveolus, forcing them both forward by improper articulation. The occasional grinding of the surfaces of the artificial molars to produce proper articulation affords another illustration of the effects of this inharmonious development.

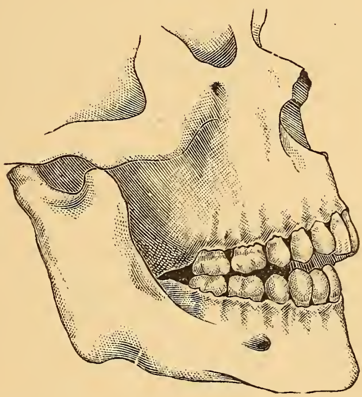
VIII. Imperfect Occlusion.

Fig. 17 illustrates a deformity produced by the before-mentioned cause; yet the result is very different. The case is that of a boy fourteen years old. Before the eruption of the second molars, the articulation was perfect; but as soon as the second molars occluded,

the jaws were forced open. The rami are so short that when the second molars and the alveolar processes of the superior and inferior maxilla come together, a space exists between the central incisors.

Unlike the former case, the superior alveolar process is remarkably well developed, and the teeth are firmly fixed in the jaw. The vault of the mouth is quite low. The position of the teeth in the alveolar process is such that when the lower teeth occlude, they strike directly on a line with the long axes of the roots, thus preventing the forward movement of the teeth and alveolar

Fig. 17.



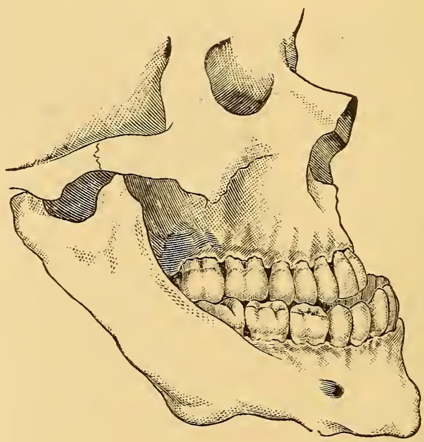
process. The inferior maxilla is not well developed, nor has it the power to overcome the resistance, and force the superior alveolar process and teeth forward, as exemplified in Fig. 16. When the rami are short, so that they do not harmonize with the maxillary bones, the movement of the jaws may be likened to the arms of shears: the farther the points are from the centre, the greater distance they have to travel. A slight movement at the centre will cause them to move a considerable distance. In a similar manner, a slight excessive protrusion of a molar will cause the anterior teeth to become separated. The shorter the rami, the less the harmony between the jaws and teeth. The farther back the protruding molar, and the more it projects, the greater the anterior separation of the jaws. The excessive eruption of the second and third molars is often due to the persons sleeping with the mouth open. Not infrequently the mal-occlusion of the teeth is due to the inability to close the jaws on account of the inharmonious develop-

ment. Occasionally there are mouths in which the molars and bicuspids occlude, and there is just enough space between the centrals to admit a thin spatula. January, 1887, a patient was brought to me for advice whose jaws, when closed, showed a space of half an inch between the incisors. The pressure of the jaws upon the molar teeth is, in some instances, so great that normal eruption is impossible. In such cases the molars will protrude through the gum, and the superior and inferior processes will occlude when the jaws meet.

IX. Protrusion of the Inferior Maxilla.

Protrusion of the inferior maxilla produces one of the most repulsive deformities of the face, and should be corrected as early in life as possible. When it is caused by or associated with arrested de-

Fig. 18.

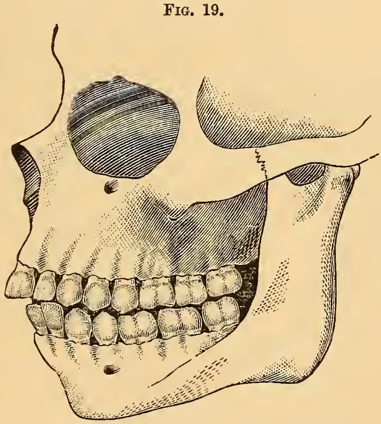


velopment of the superior maxilla, it is extremely difficult to restore the features to a natural expression. A case of considerable interest, illustrated by Fig. 18, came to my notice in 1887. A commercial traveler from New York called at my office for the purpose of having a gold crown re-set. I noticed a marked deformity in the jaws, consisting of a depression at the alæ of the nose and an unusual protrusion of the inferior maxilla. Upon examination I found that the second molar on the upper jaw and the third molar on the lower jaw were the only teeth that occluded. This was caused by

an excessive length of the rami of the lower jaw. The body was normally developed, but was carried forward by a lengthening of the rami. There are cases where the lower jaw projects beyond the upper; but by closely examining the deformity, we find that another cause exists for this appearance.

A girl fifteen years of age was sent to me for treatment by a dentist from a neighboring State. He desired me to "force the inferior maxilla back into place." I found the rami and body of the jaw apparently normal. The external appearance of the chin and cheeks was in keeping with the outline of the face. I observed that the upper lip was much depressed, and that deep lines extended from the alæ of the nose to the corner of the mouth. Upon opening the mouth, I found arrest of development of the superior maxilla. The superior incisors closed inside of the inferior incisors; the first and second bicuspids, first and second molars, were in position, but had crowded forward close to the lateral incisors. The cuspids were

Fig. 19.



quite outside of the arch. The superior dental arch had to be forced out, instead of carrying the inferior maxilla in, which would tend to further complicate the case. In the majority of cases which appear to result from a protrusion of the lower jaw, we shall find that the lower maxilla does not project abnormally; but the superior maxilla being arrested in its development gives the protruding appearance to the lower jaw. Before undertaking to correct such a deformity, the general contour of the face should be carefully studied.

A peculiar but rare deformity of the inferior maxilla is illustrated in Fig. 19. The body of the jaw is very short. A line dropped perpendicularly and touching the chin at the median line would pass through the bicuspid region of the superior maxilla. A front view of such a deformity gives an appearance as though the lower jaw were absent, and a side view throws the nose out prominently, while the chin and forehead retreat. The rami of the jaw are larger than the body. The articulation is good, the defect being that in the incisor region the teeth strike quite a distance posterior to the superior incisors. Arrest of development of the lower jaw frequently results when the superior incisors are crowded inwards irregularly. The lower incisors coming in contact with them, thus preventing the forward development of the body of the jaw.

Fig. 20.

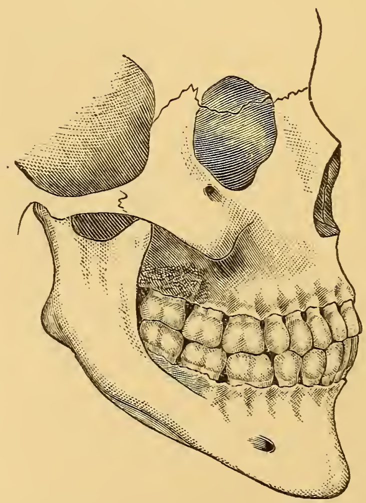


Fig. 20 represents jaws such as are frequently seen. The long body and protruding chin, narrow and contracted alveolar process on the lower jaw, a small superior maxilla and thin protruding alveolar process are in keeping with the thin faces and sharp features of the class. The body of the inferior maxilla is small, thin and very delicate; the rami unusually short—just the opposite to the one last described. A line drawn parallel with the occluding surfaces of the teeth would meet the angle of the jaw, which, in a nor-

mal jaw, would extend from one to one and a half inches below the line. Naturally slender, delicate muscles and tendons are associated with such bones. In these cases dislocation of the inferior maxilla is liable to occur while yawning or during dental operations, so great is the leverage. In this instance the length of the jaw compensated for the width, so that in this particular case the teeth are not irregular, although irregularity frequently accompanies this peculiar formation of the jaw. This is particularly the case with the saddle or V-shaped arches on the upper jaw and the saddle-shaped and forward inclination of the molars, bicuspids and cuspid teeth on the lower jaw. The roof of the mouth is also very high and the alveolar process very thin, giving the roots of the teeth but slight support. The same principle of organization and structure is operative in the alveolar process and teeth of the lower jaw.

Fig. 21.

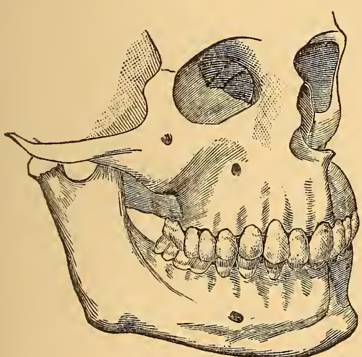


Fig. 22.

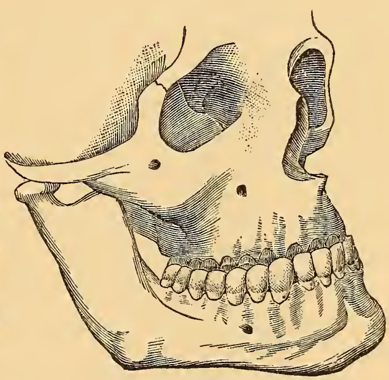


Fig. 21 represents the jaws of a patient twenty-six years of age who came to me for treatment. Upon examination I found a small normal inferior maxilla, well protruded and in harmony with the other features of the face. The superior maxilla and alveolar process were excessively developed, the first molar and anterior teeth describing a much larger circle than the lower. The second molars were the only teeth that articulated properly. The anterior alveolar process had taken on a prolific deposition of bone cells until the teeth impinged upon the gum of the lower jaw, producing absorption and expansion. The upper lip was covered with a mustache which completely hid the deformity. Under such conditions

a prominence is observed at the alæ of the nose, the upper lip being drawn over the alveolar process.

Fig. 22 represents a case often met with. The body of the inferior maxilla is excessively developed, the extent of the irregularity depending on the degree of development. When only a slight protrusion exists the incisors strike beyond the superior incisors. In extreme cases only the molars articulate. When only the anterior teeth articulate the alveolar process develops so that the teeth extend to the superior alveolar process. The features may be quite regular otherwise. This deformity is common among Negroes, and is called prognathism.

CHAPTER IV.

CONSTITUTIONAL CAUSES—Continued.

B. ANOMALIES OF JAWS THAT ARE THE RESULT OF FUNCTIONAL DERANGEMENT.

Irregularities resulting from functional derangement are confined to the individual, *i. e.*, not seen in the parents, though functional derangement of the parents usually give rise to them. Parents of such individuals may have suffered from a lack of proper nervous function due to some form of starvation, as the insane, rachitic, scrofulous, or there may have been an excess of nervous function, due to over-stimulation. Thus the second class can be subdivided under two heads:

(1) Irregularities resulting from malnutrition.

(2) Irregularities resulting from over-stimulation.

It is apparent that these two classes merge into each other, inasmuch as they both terminate in unbalanced function. Both are the result of violating the laws of nature—the former by inharmonious development and function of organs, the latter by an excess of use.

The first division is most frequently found among idiots, insane, the blind, and is generally characterized by extreme stupidity and ill-favored exterior and disease of the nerve-centres. The second division has decided neurotic tendencies, other functions being more or less impaired by these. There is often a marked degree of intellectual activity, and more or less personal beauty. Cases of this kind are usually found in good families where one or both parents have taxed the brain or the nervous system to excess.

We thus find that the children of the under-fed and the children of the over-stimulated may present abnormal jaws, though otherwise they may be very different physically, certain forms of irregularities being found both in the idiotic and the highly intellectual.

IRREGULARITIES RESULTING FROM MALNUTRITION.

I. Prevalence of Maxillary Deformities in Idiots.

Dr. W. W. Ireland has defined idiocy as "mental deficiency or extreme stupidity depending upon malnutrition or disease of the nerve-centres, occurring before birth or before the evolution of the mental faculties in childhood." A definition that seems more inclusive, and that more clearly describes the tissues of the body, is the one given by Dr. Shuttleworth: "A vice of the entire organism; an affection not only of the nervous system but of the functions generally of organic life." Not a tissue of the body is exempt; the phenomena that check development of the brain-tissues will also interfere with proper development of the other tissues of the body.

No part of the body has received the impress of disease so markedly as the osseous system, and yet pathologists have given this part of the idiotic system but little attention. This osseous system seems to have been constructed regardless of symmetry or uniformity. While in the normal individual the lateral halves are never uniform, in the feeble-minded the greatest asymmetry prevails. This want of harmony is more apparent in the maxillary bones because of their peculiar formation and environment. The close proximity of the jaws and their articulation permit of irregularities being readily observed At the beginning of my examinations I observed that other deformities than the V- and saddle-shaped existed, all of which must be considered. I found both excessive and arrested development of the maxillary bones; arrest of the one and excessive development of the other; protrusion of the upper or lower jaw; high or low vault; partial V- and partial saddle-shaped arches; semi-V and semi-saddle-shaped arches; semi-V and semi-saddle-shaped on the same side, and small teeth.

Of late years some American investigators have made examinations among the inmates of our institutions for idiots, and reported that they found about the same proportion of irregularities as may be seen in ordinary practice.

I believe myself warranted in the assertion that a much larger percentage of deformities of the teeth and jaws exists among a given number of imbeciles, deaf and dumb, and blind than in the same number of normal individuals, the various conditions being the result either of arrested development or excessive growth.

It is obvious that any condition of malnutrition, particularly if existing during the period of embryonal and infantile growth and

development, which is sufficiently marked to cause perversion of growth in the complex nervous centres, must necessarily affect the tissues in general. Nerve-tissues have relatively greater vitality than the other tissues of the body, and every physician knows that the brain and spinal cord will often functionate after the other structures of the body have been seriously impaired by disease.

The varying opinions among scientific men on either side of the Atlantic led me to investigate the subject carefully. The examinations were made by myself and by able dentists in the following named institutions:

Asylum for Idiots of the State of New York, at Syracuse; Massachusetts School for Feeble-minded, at South Boston; Illinois Asylum for Feeble-minded Children, at Lincoln; Asylum for Idiots, Randall's Island, N. Y.; Minnesota Training-school for Idiots and Imbeciles, Faribault; Kansas State Asylum for Idiots and Imbeciles, South Winfield; Cook County Insane Asylum, Dunning, Ill.; Pennsylvania Institution for Feeble-minded Children, at Elwyn.

(Special reports may be found in the Transactions of the International Medical Congress, 1877, and in the Annual, 1888.)

The following tables show the total number of irregularities in each grade and sex:

Total Deformities in the Jaws.*

No.	..	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Parital V-Shaped Arch.	Thumb-Sucking.	Saddle-Shaped Arch.	Small Teeth.
1977	...	1095	152	92	159	318	129	236	31	207	71
Per cent.		55.3	7.6	4.6	7.9	16.	6.5	11.9	1.5	10.4	3.5

The above tables show that almost one-half of the whole number examined had irregularities of the jaws and teeth. The examined children were over nine years of age. Under that age irregularities might be considered as of local origin, while constitutional and developmental irregularities do not appear until the eruption of the incisors and first permanent molars. As would be expected, the

* All tables show irregularities that are the result of small jaws.

largest percentage of irregularities is found in the low-grade class; and it is seen that the normal classes in the high and middle grades vary only about 12 per cent.; the middle grade showing the largest percentage of normal jaws and teeth, the high grade the next, and the low grade the fewest number of normal cases.

The mental capacity of the idiot can indicate in a general way only the abnormal condition of the osseous as well as muscular, venous and arterial systems of the individual; thus, a high-grade idiot might possess an atrophied condition of any of the tissues of the body, while a low-grade idiot might develop any or all of the tissue to an excessive degree, thus depending, of course, upon the inclination and condition of the blood-supply. Thus the arterial and nervous systems might be atrophied on one side, lessening the supply of blood to that side or limb, and producing atrophy of the muscular and osseous tissues on that side. The opposite effect might be produced on the other side; a large amount of blood would be carried naturally to the extremities of the other side, causing hypertrophy of tissue.

If these tissues of the body are so prone to take on abnormal conditions, certainly the jaws must suffer more or less. I have observed three conditions that account for nearly all the irregularities of the jaws and teeth: excessive development, arrest of development, and inharmonious development of the maxillary bones. These abnormalities are developed with the osseous system, and may be properly termed constitutional or developmental.

When excessive development occurs in one jaw, and the other is normal, or arrested development ensues, then the teeth in the abnormally large jaw protrude.

If the cranium is large, the superior maxilla is usually larger than normal. When the inferior maxilla is involved, the rami are as likely to be enlarged as the body of the bone. Sometimes the rami and the body develop uniformly. When there is excessive development of a part or all of the bone, protrusion of the lower jaw and teeth takes place. I have seen cases in which one-half of the superior and inferior maxillæ, as well as one-half of the cranium, was larger than the other. In these irregularities of the jaws, however, irregularities of each set of teeth are seldom seen. While it is proper to speak of these conditions as irregularities, yet they are so only as one jaw is related to the other.

I have already shown, in a paper read before the Dental Section of the American Medical Association in 1888, that irregularities of the teeth, which I have termed constitutional, prevail to a greater extent among the idiotic, deaf and dumb, and blind than among an equal number of strong and well-developed persons; that not only is the brain-matter deficient in the feeble-minded, but that many cases are seen which show that the osseous system is generally defective; and that when the bone-tissue is arrested in development from malnutrition, the maxillary bones are affected.

It is frequently the case that when idiocy appears in a family, other members of the family are observed to be scrofulous, deaf, dumb, blind, or insane, showing that the conditions indicating neurotic tendencies have been transmitted through generations.

In his work on "Insanity in Norway," Ludwig Dahl gives many instances in which the result of this tendency is deafness, dumbness, or insanity, as often as idiocy. He says, "Acquired insanity and idiocy frequently appear side by side in the same family stock. Deaf-dumbness occurs frequently." He has traced the genealogies of a number of families, and has brought to light a number of interesting facts. In his genealogy of No. 3, the Ejvinds family have nine insane or idiotic, four deaf and dumb, and one epileptic. Other families showed a similar proportion of mentally and physically deformed persons.*

In his work on "Idiocy and Imbecility," p. 528, Dr. Ireland says, "Deafness frequently occurs in families where some of the other members are idiots." And again, on page 16, "The children of epileptics are frequently insane or idiotic or hysterical, and the descendants of an insane person are often epileptic, idiotic, or insane. Deaf-dumbness, chorea, locomotor ataxia, hysteria, and other disorders of the nervous system now and then occur in the descendants, apparently as the result of an inherent neurotic tendency in the family."

In the report of the Commissioner on Idiocy appointed by the Legislature of Connecticut (see Report of Commissioners on Idiocy to the General Assembly of Connecticut, New Haven, 1856, p. 35), it was found that out of seventy cases of idiocy there were ten cases

* Lombroso has called attention to deformities of the jaws among the born criminals.

of idiotic parents, six insane persons, six insane relatives, eight epileptic parents or relatives, eight blind and two melancholic.

Dr. Howe shows (" On the Causes of Idiocy," Edinburgh, 1858, p. 35) that in seventeen families in Massachusetts the heads of which were blood-relations, there were born ninety-five children, of which forty-four were idiotic, twelve scrofulous and puny, one deaf, and one a dwarf. Morel and the school of investigation which he founded point out that the defective classes—*i. e.*, the congenital deaf mute, blind, lunatic, idiotic, criminals, and paupers—are buds on the same tree of human degeneracy. In dealing with the evidences of degeneracy they cite defective teeth as one of the signs in most instances. These signs are atavism or reversion to lower types of structure and function. Many more cases could be given showing that a relation exists between the deaf, dumb, blind, and insane, but it is evident that the offspring of parents showing neurotic tendencies and symptoms are subject to these conditions. Medical men have commonly classified these lesions under the same head, and some specialists go so far as to classify the criminal and drunkard in this category. I have recently read an article from a French journal in which a left-handed person was also included.

While specialists have generally concluded that most of these conditions are derived from a common neurotic ancestry, the only common feature is a very low grade of cerebral development. In my investigations concerning the osseous system in its relations to the irregularities of the jaws and teeth, I have observed a lesion common to all these conditions. With this object in view I have made examination of the mouths of all these classes except the criminal, and these I hope to examine in the near future. I found great difficulty in enlisting sufficient interest on the part of superintendents of Blind Asylums to enable me to make proper examinations of the blind, their reason being that the sensitive nature of the patients would not permit of their exhibiting the mouth for examination. I have conducted a sufficient number of examinations, however, to make some estimate of the percentage of deformities of the jaws and teeth.

II. Prevalence of Maxillary Deformities among the Deaf and Dumb.

The greatest interest has been shown by the superintendents of Deaf and Dumb Institutions, thus enabling me to make very satis-

factory examinations. In some of the institutions visited, the blind are retained with the deaf and dumb; when such was the case the blind were classed with the deaf and dumb. The examinations were made either by myself or by able dentists living in the town or city where the institution was located. Examinations were made in the following institutions:

Minnesota School for the Deaf, Faribault, Minn.
Portland School for the Deaf, Portland, Me.
Oregon School for Deaf Mutes, Salem, Oregon.
Milwaukee Day School for the Deaf, Milwaukee, Wis.
Arkansas Deaf Mute Institute, Little Rock, Ark.
Washington School for Defective Youth, Vancouver, Wash.
Iowa Institute for Deaf and Dumb, Council Bluffs, Iowa.
Clarke Institute for Deaf Mutes, Northampton, Mass.
Evansville Deaf-Mute School, Evansville, Ind.
Institution for the Deaf, Dumb and Blind, Berkeley, Cal.
Kansas Institute for the Deaf and Dumb, Olathe, Kan.
Institute for the Deaf and Dumb, Austin, Texas.
Nebraska Institute for the Deaf and Dumb, Omaha, Nebr.
Alabama Institute for the Deaf and Blind, Talladega, Ala.
Indiana Institute for the Deaf and Dumb, Indianapolis, Ind.
New Jersey School for Deaf Mutes, Trenton, N. J.
South Carolina Institution for the Education of the Deaf, Dumb and Blind, Cedar Springs, S. C.
Western Penna. Institute for the Deaf and Dumb, Pittsburgh, Pa.
Colorado Institute for the Deaf and Dumb, Colorado Springs, Colo.
Northern New York Institute for Deaf Mutes, Malone, N. Y.

The following tables show the result:

TOTAL DEFORMITIES IN THE JAWS OF THE DEAF AND DUMB.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
1111	Male.	538	197	41	116	241	91	115	108	51
824	Female.	363	108	51	89	177	78	77	95	62
1935	...	901	305	92	205	418	169	192	203	113
Per cent.		45.3	15.7	4.7	10.5	21.7	8.7	9.9	10.4	5.8

Two cases cleft palate.

III. Maxillary Deformities among the Blind.

Examinations were made in the following-named institutions for the blind:

Maryland School for the Blind, 339 N. Charles Street, Baltimore, Md.

Maryland School for the Blind and Deaf and Dumb, North Boundary Avenue, Baltimore, Md.

Kentucky Institute for the Blind, Louisville, Ky.

New York Institute for the Blind, 9th Ave. and 34th St., New York.

Total Deformities in the Jaws of the Blind.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
107	Male.	53	8	9	10	20	4	3	6	7
100	Female.	52	8	7	5	18	3	6	5	3
207	...	105	16	16	15	38	7	9	11	10
Per cent.		50.7	7.7	7.7	7.2	18.3	3.3	4.3	5.3	4.8

One case cleft palate.

In the following table are shown the results of the examinations of the mouths of the insane:

Maxillary Deformities among the Insane.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle Shaped Arch.	Small Teeth.
430	Male	394	10	4	2	18	12	29	3	5
270	Female	226	8	6	4	26	14	18	9	2
700		620	18	10	6	44	26	47	12	7

Examinations of the mouths of seven hundred insane patients at the Cook County, Ill., Insane Asylum and the Illinois State Insane Asylum, as shown in the table revealed the fact that only about 12 per cent. were irregular, the irregularities consisting of protrusion of the upper and lower jaws, partial V-, and very few saddle-shaped

arches. The high arch was quite conspicuous among these people. Some of these irregularities were due to local causes. These irregularities were among cases of congenitally insane patients, or patients who had become insane early in life. These observations were not confined to the hereditary types.

With few exceptions, insanity does not appear in the individual until the skeleton has attained its normal development. There were irregularities of the teeth produced by local causes. It is probable that a large percentage of constitutional irregularities of the teeth could be found in the mouths of inmates of our private asylums, where there are more hereditary cases.

The following table is the result of examination of the mouths of children in the Hebrew Orphan Asylum, New York City, by Dr. S. Freeman:

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle Shaped Arch.	Small Teeth.
86	Male	65	3	3	4	2	3		5	1
69	Female	50	3	2	3	3	4	3	1	
155		115	6	5	7	5	7	3	6	1
Per cent. .		74.	3.8	3.2	4.5	3.2	4.5	1.9	3.8	

The large percentage of irregularities among these children may be due, to a great extent, to consanguinity.

Deformities of the Maxilla among Children apparently non Defective.

Dr. Louis Ottofy, in his paper on "The Incipiency of Dental Caries," read before the joint meeting of American and Southern Dental Associations at Louisville, on August 30, 1888, reported an examination of the mouths of 623 children,—317 males and 306 females. These children were pupils in the public schools at Grand Forks, Dakota; Lebanon, Ill., and Chicago. The following table shows the percentage of irregularities:

6

Age.	Irregular.	Regular.
5	0 p. c.	100 p. c.
6	9	91
7	27.5	72.5
8	43	57
9	14	86
10	31.5	68.5
11	32.5	67.5
12	25	75
13	20	80
14	35	65
15	28	72

It will be seen that the largest percentage of irregularities is found at the age of eight years. The cuspid teeth are appearing at this time, and at least one-half of the irregularities are due to local causes. At the age of thirteen but 20 per cent. of the cases showed deformities; nature and a judicious use of the forceps had corrected many of them. At the age of fifteen, 28 per cent. of the teeth were irregular. I venture the opinion that if these examinations could have been extended to the age of twenty years the percentage of irregularities would have diminished. The development of the jaws at this age would allow nature to reduce many of the abnormal conditions.

The following table shows the results of examinations of mouths of one thousand children over twelve years of age, made by myself

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
396	Male	313	11	3	5	26	5	18	12	13
604	Female	467	8	4	2	30	6	43	21	17
1000		780	19	7	7	56	11	61	33	30
Per cent. .		78.	1.9	.7	.7	5.6	1.1	6.1	3.3	3.0

The difference between Dr. Ottofy's percentages and those shown in the above table is accounted for by the fact that in his table both local and constitutional causes are included, while in mine the many deformities due to local causes are excluded.

Nearly all of these cases were residents of Chicago and had been attended by the dentist regularly. These irregularities, therefore, might be classed as constitutional or developmental, as they could not be prevented by the dentist by the use of the forceps. We naturally suppose that the majority of the children examined by Dr. Ottofy, living as they did in the country, had received but little attention from the dentist,—which would account for the presentation of more irregular cases than among those examined by me. It is possible also that some of those I examined had had slight irregularities corrected while they were young, thus preventing serious complications when maturity was reached. I should expect to find quite a difference in the percentage of irregularities in different parts of the country. When people are confined in-doors, and do brain-work chiefly, as do those living in cities, they are likely to have more irregularities than the country people. So also among those living in old parts of the country, as the New Englanders, rather than in residents of a new part of the country. The following table will bear me out in this statement. The examination was conducted by Dr. P. N. Moriarty, demonstrator at the Harvard Dental School, Boston. The examinations were made in the mouths of those persons seeking the services of the students, consequently were from poorer classes.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Thumb Sucking.	Saddle-Shaped Arch.	Small Teeth.	Arrested Development.
80	Male	44	3	5	1	9	1	6	1	6	1	0
143	Female	91	2	8	10	8	6	7	1	11	3	1
223		135	5	13	11	17	7	13	2	17	4	1
Per cent. .		60.	2.2	5.8	4.4	7.6	3.1	5.8	0.8	7.6	1.7	

A comparison between the tables showing irregularities found in the mouths of defective persons and those found in the mouths of normal persons shows an excess of the former, the ratio being that of about 45 per cent. to 22 per cent. Although statistics cannot be made to include all institutions, the number examined, thirty-five, is sufficiently large to give a fair average, even when due allowance

is made for differences of opinion among different examiners. The author's observations and examinations in various institutions verifies the correctness of these statistics. It may be urged by some that those deformed from birth should be ranged under a separate head, it being supposed that such persons show the worst forms of irregularities. The author's opinion does not coincide with this view. Some of the worst forms of irregularities are found among persons that become idiots or insane late in life. Likewise very defective jaws are found among persons of neurotic tendencies and great intelligence, though not deformed, as will be shown later on. The tables show that these deformities are found among defective persons, like deaf, and dumb, and blind, as well as among idiots, to which class of defective persons older authors limit irregularities. Recent French authors go even farther and include criminal classes among the list. Of course, all statistics furnish data only approximately correct, inasmuch as they cannot include all cases; but the greater number of cases included, the more nearly correct are inductions.

In the foregoing argument we have taken the stand that irregularities are more common among persons suffering from malnutrition and defective nerve-centres, and are consequently the outgrowth of these abnormal functions. To make this more clear, it is well to examine the various causes of idiocy, and other forms of deformity.

Consanguinity in its Relation to Deformities in General.

Consanguineous marriages not infrequently result in mental aberrations in the progeny. Dr. Howe states that in seventeen families, the heads of which were related by blood and intermarriage, the result was fearful. Most of the parents were intemperate or scrofulous, and some combined both evils, so that it must be admitted there were other causes besides consanguinity to increase the probability of infirm offspring. There were born in these families ninety-five children, of whom forty-four were idiots, twelve others were scrofulous and puny, one was deaf and one was a dwarf. In some of the families all the children were either idiotic or very scrofulous and puny. In one family of eight children five were idiotic. The commissioners of idiocy in Connecticut found in one hundred and sixty cases of idiocy, twenty which apparently resulted from consanguineous marriages. Of these, twelve were children of

first cousins, three of second cousins, one of third, and four of distant relations. Dr. Langdon Down found that out of seven hundred and fifty-three male idiots thirty-three were the offspring of first cousins, three cases of second cousins, and four of third cousins,—in all forty cases out of seven hundred and fifty-three, or rather more than five per cent. Of the two hundred and ninety-five females, thirteen were the children of first cousins, three of second cousins, and four of third cousins,—in all twenty among two hundred and ninety-five, or a little less than seven per cent. His researches show that in England at least every fourteenth idiot is the child of cousins. The majority of cases of idiocy appear at birth, and many such may be traced to habits or tendencies of ancestors. Often it is difficult to determine in what generation the germs of the disease were planted. Ludwig Dahl, of Norway, in his work on "Insanity," shows, by means of a genealogical tree, how an apparently healthy couple may have children, grandchildren and great-grandchildren affected with idiocy and insansity. In reviewing the field of possible causes of idiocy, I am greatly impressed by the apparent influence of consanguineous marriages. Dr. S. M. Bemis, of New Orleans, has found, through his examination of statistics supplied by a number of physicians, that among two thousand seven hundred and seventy-eight children, the fruits of intermarriage of first cousins, seven hundred and ninety-three were normal; one hundred and seventeen deaf and dumb; sixty-three blind; two hundred and thirty-one idiotic; twenty-four insane; forty-four epileptic; one hundred and eighty-nine scrofulous; fifty-three deformed; six hundred and thirty-seven died early.

Scrofula as a Cause.

The most common lesion accompanying idiocy is some form of scrofula, such as strumous ulcers, skin eruptions, abscesses, enlarged and suppurating glands, diseases of the eye and ear,—these diseases being quite general attendants of idiocy. A very large proportion of all persons affected with idiocy die of consumption of the lungs, which is of all diseases most often associated with what may be termed a defective make-up. Dr. Ireland says that at least two-thirds of the idiot class are of scrofulous constitutions. Is arrested development of brain-tissue the result of scrofula, or do scrofula and idiocy proceed from a common cause? is a question which is often

propounded to physicians. In the light of recent observations, I am personally of the opinion that when the two conditions are associated they are dependent upon a common cause; never in my opinion do they bear the relation to each other of cause and effect. The teeth, as we well know, are affected in their development and growth by scrofula and other constitutional defects. The other organs and tissues of the body may not outwardly show such defects as plainly as do the teeth, but the result of any constitutional disease will nevertheless be apt to exist in a form quite as markedly pathological.

Drunkenness in Parents.

There is a wide variance of opinion among medical men regarding the probable influence of intemperance of parents in the production of idiocy and allied conditions in their offspring. Dr. Langdon Down is emphatic in his opinion that drunkenness at the time of conception is liable to produce serious results upon the brain of the child. Ludwig Dahl believes that the abuse of brandy in both father and mother is one cause of the large number of idiots in Norway. On the other hand, Dr. C. T. Wilber, of the Illinois State Asylum for Idiots, states that in three hundred and sixty-five idiotic patients eight only claim drunken parents. Dr. Graham, superintendent at Earlswood, England, also states that he found among eight hundred inmates of that institution but six cases of idiocy which could be attributed to intemperance of parents. Whether or not drunkenness is responsible for idiocy we cannot decide, but we know positively that intemperate habits are transmitted from generation to generation, each series of progeny in the line of descent showing a lower grade of intellect. As further illustration I cannot do better than quote Dr. Shuttleworth:

"Considering the intimate and prolonged dependence of the child upon the mother during gestation and nursing, one would suppose *a priori* that maternal rather than paternal drunkenness would count most in the production of idiocy. In the cases which I have tabulated, drunken fathers preponderate in a majority of thirteen to four. Possibly the mental anxiety entailed upon the wife by a drunken husband during the impressionable period of pregnancy may in part explain the discrepancy. Whatever the direct effect of drink upon the fetus in utero, there is little doubt that such nursing as a child is likely to obtain from a drunken mother will intensify any predispo-

sition to mental defect. The baneful practice of giving infants alcoholic drinks seems to prevail to a great extent in Sweden and Norway. Such practice may in part account for the extensive prevalence of idiocy and juvenile insanity in Scandinavia, as described by Ludwig Dahl."

Pre-Natal Influences and Intra-Uterine Education.

It is unquestionably a fact that a fright to a mother during pregnancy is occasionally a cause of idiocy in children. Women instinctively shrink from anything which would produce a shock or special mental impression during the period of gestation, fearing for both the mental and physical welfare of the child. Strange to say, the same maternal instinct prevails with the brute creation.

Dr. G. H. Fisher has written a very complete history of the "Literature, Classification, and Description of Human and Brute Monstrosities," including the so-called parasitic monster known as "Fetus in Fetu," and the various supernumerary formations of parts and organs which are familiar to medical men. Many interesting cases are given by this author, including deformities of the upper and lower extremities and internal organs. He shows that the lower animals may become insane, and that heredity and pre-natal shocks have much to do in producing these conditions.

Innumerable cases of pre-natal shocks producing idiocy, where the parents were both apparently healthy, are on record. In one case the news of the loss of the husband at sea had the effect of impairing the intellect of the unborn child. Again, the same result occurred in another case as a result of fright occasioned by a team of horses running away with the mother when well along in utero gestation. Baron Percy, a French military surgeon, observed that out of ninety-two children whose mothers had been exposed to the terrors of a tremendous cannonade at the siege of Landau, in 1793, sixteen died at the instant of birth; thirty-three languished from eight to ten months, and then died before the age of five years; and two were born with numerous fractures of the bones of the limbs.*

The authorities for the above are "Medicine in its Relation to the

* Trans. N. Y. State Med. Soc., 1865–68.

Mind,'' Dickson; Griesinger on "Mental Diseases;" "Insanity," by George H. Savage; Ireland's work upon "Idiocy and Imbecility," and the "Transactions of the Association of Medical Officers of American Institutions for Idiots and Feeble-Minded Persons."

The result of the various lesions and pre-natal impressions already mentioned is not only mental in character, but we invariably find arrest of development of brain-substance in idiots, imbeciles and feeble-minded children, the different terms indicating the degree of mental development. It is to be observed that a majority of these cases are affected by impressions made upon the fetus in utero through the influence of the parents. A few cases, however, are mentioned as resulting from diseases or injuries occurring soon after birth or in childhood. If arrest of development of brain-tissue occurs in utero or in early childhood, other organs or tissues of the body are likely to be similarly affected. The brain of the idiot is lighter and has fewer convolutions than the normal brain, and also differs in that the convolutions of the idiot's brain correspond on both sides, like the monkey's, while they vary in the normal human brain. The anterior lobes of the cerebral hemispheres are imperfectly developed, and where the head is unusually small the antero-posterior diameter of the cerebral hemispheres is shortened. Irregularity of the two halves of the brain is commonly observed.

The cerebellum, pons Varolii and medulla oblongata are smaller than normal with almost perfect asymmetry. Not infrequently portions of the brain are altogether absent; absence of the entire cerebellum and a rudimentary condition of one or both olivary bodies, peduncles, optic thalami and corpora striata having been noticed. Griesinger, in his work on "Mental Diseases," mentions a number of interesting cases, one of which we will cite. The brain examined was that of a girl seventeen years of age, who presented the highest type of idiocy, in conjunction with a generally defective physique. The conditions present were very interesting, and may be briefly described as follows: The middle free portion of the corpus callosum was entirely absent, as were also apparently the septum and the middle portion of the fornix. The anterior and white commissures of the gyrus fornicatus were decidedly rudimentary. The convolutions presented an abnormal grouping, and the island of Reil was greatly atrophied. Some of the convolutions were entirely absent. The lobes of the cerebellum were asymmetrical.

Dr. A. Wilmarth, of the Pennsylvania Institution for Feeble-Minded Children, says, "In six brains, the island of Reil was exposed through the defective development of the third frontal convolution; in four cases on two sides, in two on one side only. In eighteen brains six were found where the cerebrum failed to cover the cerebellum by from one-eighth to five-eighths of an inch."

I could quote indefinitely from eminent authorities at home and abroad to show that not only are the different structures of the brain of the average idiot atrophied and often entirely wanting, but that diminution of weight is the rule. Enough cases have been cited to give a general idea of the defects in anatomical structure.

Having determined the constant relation of defective cerebral development to idiocy, it remains to be proven whether the defective condition is a special one affecting the brain only, or is an integral part of the generally defective or mal-development, or at least of a general tendency toward such perversions of growth. When we take into consideration the fact that the fetus is developed in two lateral halves, which may or may not develop harmoniously, and may or may not fuse together properly, it becomes logical to presume that any influence which tends to produce inharmony and asymmetry of growth in one part of the body—*e.g*, the brain—must necessarily tend to produce the same conditions in other portions of the fetal halves, providing such influence is not a purely local one. The causes of idiocy not being local, but general, the inference is obvious. It is astonishing to me that the superintendents of institutions for the feeble-minded have made so little note of the asymmetrical relations of the two lateral halves of the body, in the cases under their care. Personally, I am of the opinion that harmony of members does not generally prevail in the anatomy of the idiot. In examining the inmates of various institutions, I was struck with the numerous examples of arrested development, hypertrophy and asymmetry of upper and lower extremities. These abnormal conditions accord with the types of cerebral mal-development already cited.

In a paper by Dr. G. E. Shuttleworth, England, presented before the International Health Exhibition, London, August 2, 1884, upon "The Health and Physical Development of Idiots as Compared with Mentally Sound Children of the same Age," he says: "Many idiots are undoubtedly small at birth; not a few have been brought into

the world prematurely, but in nearly all imperfections of functions interfere with due nutrition and development, as the following table will demonstrate:

TABLE *showing the* RELATIVE MEAN STATURE *and* WEIGHT *of the General Population, and of Twelve Hundred and Nine Idiots and Imbeciles in Earlswood, Royal Albert, and Larbert Asylums.*

Age last Birthday.	Height.				Weight.			
	General Population.		Idiots and Imbeciles.		General Population.		Idiots and Imbeciles.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
	Inches.	Inches.	Inches.	Inches.	Pounds.	Pounds.	Pounds.	Pounds.
5	41.0	40.55	40.0	39.5	. . . .	39.2	39.0	37.5
6	43.0	42.88	42.25	41.25	. . . .	41.7	43.0	41.0
7	45.0	44.45	44.0	43.25	. . . .	47.5	46.5	45.0
8	47.0	46.60	45.75	45.25	55.0	52.1	50.5	49.0
9	49.0	48.73	47.5	47.5	60.0	55.5	55.5	53.0
10	51.0	51.05	49.0	49.0	65.0	62.9	59.0	59.0
11	53.0	53.10	51.0	51.0	70.0	68.1	64.5	66.0
12	55.0	55.66	52.5	53.0	77.5	76.4	70.5	72.0
13	57.5	57.77	54.75	55.0	85.0	87.2	77.0	80.0
14	60.0	59.80	56.5	56.5	92.5	96.7	85.5	88.0
15	62.0	60.93	59.25	58.0	102.5	106.3	94.5	95.0
16	64.0	61.75	60.75	59.0	117.5	113.1	103.0	102.0
17	65.5	62.52	62.5	59.25	135.0	115.5	110.0	106.0
18	66.5	62.44	63.25	. . . .	142.5	121.1	116.0	108.0
19	67.0	62.75	63.25	. . . .	143.7	123.8	120.5	108.5
20	67.25	62.98	64.0	59.5	145.0	123.4	121.5	108.5
21	67.5	63.03	64.25	. . . .	146.2	121.8	122.0	. . . .
22	. . . .	62.87	64.5	. . . .	147.5	123.4	122.5	. . . .
23	. . . .	63.01	. . . .	. . . .	148.7	124.1	. . . .	. . . .
24	. . . .	62.70	. . . .	. . . .	150.0	120.8	. . . .	. . . .
25–30	67.75	62.02	64.75	59.75	151.2	120.0	123.0	109.0
30–40	. . . .	. . . .	. . . .	. . . .	152.5	120.8	. . . .	. . . .
40–50	. . . .	61.15	. . . .	. . . .	155.0	118.6	. . . .	. . . .
50–60	68.0	. . . .	. . . .	. . . .	157.5	104.0	. . . .	. . . .

"It will be observed that idiots are shorter than the general population,—at five years, by one inch; at ten years, by two inches; at fifteen years, by three inches; at twenty years, by three inches. While, as regards weight, male idiots are lighter than the general population,—at eight years, by four and one-half pounds; at ten years, by six pounds; at fifteen years, by eight pounds; at twenty years, by twenty-three and one-half pounds; the disparity being greater in the male than in the female sex. It appears that the relative rate of growth of the two sexes of idiot children follows the same rule as that of normal children, and is subject to the same

variations at the age of puberty, for two years preceding which the growth of girls is in excess of that of boys."

Abnormally-shaped Heads.

If the mental capacity could, in all instances, be measured by the size and form of the head, many among the idiotic would rank high. The shape and size of the skull are indicative of the mind only in a general way, the feeble-minded being about equally divided between abnormally large and small heads. The measurement of the ordinary well-balanced head ranges from twenty to twenty-six inches in circumference, and that of the idiotic head from twelve to thirty-six inches. Opinions vary in regard to the average size of the microcephalic idiots, some claiming that all heads of sixteen inches and under come under this class, and others that thirteen inches in circumference is the average microcephalic head; while on the other hand all heads which measure more than twenty-six inches in circumference would be considered either macrocephalic or hydrocephalic.

The extreme cases are comparatively few in the institutions. Out of six hundred inmates of the Pennsylvania Institution at Elwyn, which I examined with the assistance of the superintendent, Dr. I. N. Kerlin, and Dr. Wilmarth, I found but twenty-eight microcephalic, twenty-four macrocephalic and three hydrocephalic cases. We shall find these extreme cases exceedingly interesting in the study of the etiology of irregularities of the teeth, and shall give special attention to their relations later. There is a certain size of the head below which an individual must be an idiot. Voisin says that "the proper exercise of the intellectual qualities is impossible with a head of from eleven to thirteen inches in circumference, and a measurement of eight to nine inches from the root of the nose to the posterior border of the occipital bone." Irregularities in the external surface of the cranium predominate in every idiotic head, and in such variety that no two heads are found alike. These conditions show a want of development of the brain. The brain substance being the first to obtain its growth, the cranial bones are molded about it, and are, in a manner, supported by it until the sutures have united. If the brain be slow in developing and shaping, ossification of the sutures is retarded; should the brain, or parts of it, be retarded in growth, the cranium would be either mi-

crocephalic or asymmetrical in its development. Again, inharmonious closure of sutures may also produce unilateral contractions of the bones of the head. I do not wish to convey the idea, however, that asymmetry in the cranium is always the result of malformation of brain-tissue, as by far the majority of cases result from arrested development or interruption in the growth of bone tissue. *Per contra*, I am well aware that perfectly symmetrical heads are rare in even normal individuals. The diagrams in possession of our hatters tell a woful tale, not at all flattering to our racial self-conceit. This retarded growth may result from constitutional disturbances acting unfavorably upon general nutrition, or from inflammatory conditions of the osteophytic membrane, which may take place in utero, thus prematurely closing the sutures. There is no law governing the development of the brain and the closing of the cranial sutures. Those bones the sutures of which close before the proper time will be narrowed at the point of premature fusion. It is reasonable to expect that when bones prematurely ossify at one part of the cranium, dilation will take place directly opposite, as the brain grows in the direction of the least resistance. This explains many peculiar deformities of the head. Again, if the majority of the sutures ossify prematurely, microcephalus may result. It appears reasonable also to infer that the shape of the basis cranii will be affected in a similar manner by too early or too late ossification. These changes are caused by improper nutrition of the bones and cartilage. A knowledge of this fact gives us a clear conception of the relation which various general conditions bear to idiocy and imperfect development in general. The influences of such perversions of nutrition as are produced by syphilis, tuberculosis, struma and intemperance over the ossification and growth of bone is a most patent one. The shape of the base of the skull and the contour of the face depend largely upon the ossification of the sutures. When ossification of the cartilages occurs early, a shortening of the basis cranii results. Especially is this the case when premature ossification occurs in connection with the sphenoid bone. The age when the basilar portion ossifies in a normal subject is from fifteen to twenty years. Thus too early ossification naturally produces a shortening in the antero-posterior direction, which causes serious deformities in the shape of the face, and an abnormal curvature at the base of the brain. The superior maxillary bones are attached to the

bones of the head and face by eight articulations, and as the ossification of the sutures occurs at about the same time as the ossification of the sutures of the basis cranii, the same influences which affect the cranium must also affect the superior maxilla. These conditions may account for family features not presenting themselves until middle age. This is a strong argument in favor of postponing the operation of regulating teeth until the contour of the face has been permanently established. When there is inflammation of the membrane in utero (which is of common occurrence), the sutures ossify before or soon after birth, and as a result the base of the cranium will assume and remain in an undeveloped condition, causing the face to present an abnormal shape and size, which will broaden the face, throw the cheek bones out prominently, make the nose broad and flat and sunken, and extend the space between the eyes, giving as a whole a face void of expression. When the sutures at the base of the skull ossify normally the antero-posterior diameter is longer, the base of the cranium is more angular, the features sharper, with the eyes closely set, and a face full of expression. The sphenoid bone does not attain its full size until from the twenty-fifth to the thirtieth year of age.

I am of the opinion that, when the bones at the basis cranii ossify before or shortly after birth, the superior maxilla and septum nasi assume a decidedly unnatural form.

Dr. Oakley Coles, in his work upon " Deformities of the Mouth," ascribes the different deformities of the jaw to premature ossification either of the sutures or the basis cranii. Thus he says that " the deformity known as inter-maxillary prognathism is the result of a force operating on the inter-maxillary bone, such force originating in the body of the sphenoid, and being transmitted by the intervening nasal septum." He says also, page 93, " After carefully examining the works of various writers on the subject of microcephalic idiocy, there seems sufficient evidence to justify the belief that premature ossification of the sutures is the rule in a majority of cases of microcephalus, and we may therefore assume, if we cannot absolutely conclude, that this influence operates powerfully in the production of the dental deformity known as the lambdoid jaw" (or V-shaped arch).

While, as has already been observed, I believe that premature ossification of the sutures and basis cranii is followed by deformities

of the jaw and septum nasi, I do not think that they bear to each other the relation of cause and effect. In this I beg leave to differ with Dr. Coles. It is unnecessary to expatiate upon this subject here, as it will be the principal topic for discussion in another chapter.

We have considered above the morbid influences of various disorders in producing a vicious condition of the entire system called idiocy. It would be erroneous, however, to conclude that this is the sole effect of these disorders, nor are excessive and arrest of development limited to idiots, but they may be found in any portion of the osseous system, as appears from perusing the literature referred to below.

BIBLIOGRAPHY.

(1) Hutchinson, J. "Arrested Development of the Radius, Fore-arm and Hand." Tr. Path. Soc. London, 1865–6, xvii. 223, 226.

(2) Leroy. "Arrêt de Développement de l'Avant-bras Gauche." Revue Photog. des Hôp. de Paris, 1871, iii. 80–82.

(3) Rodenstein. "Case of Arrested Development of both Upper Extremities." Am. J. Obst., N. Y., 1876, viii. 603–663.

(4) Shattuck. "Case of Arrested Development and Growth of the Right Upper Limb in a Man." Tr. Path. Soc. Lond., 1881, xxxii. 276–280.

(5) Cayley, W. "Arrested Development of Fore-arm and Hand." Tr. Ibid., 1865–6, xvii. 430.

(6) Chipperfield, W. N. "Curious Arrest of Development of the Hand." Madras Monthly J. M. Soc., 1873, vii. 409, pl.

(7) Doran, A. "A Case of Arrested Development of the Bones of both Fore-arms; Extreme Senile Changes in the Osseous Tissues." Tr. Path. Soc. Lond., 1876, xxvii. 314, 316.

(8) Dreyfous, F. "Arrêt de Développement du Membre Supérieur." Progrès Méd., 1878, vi. 483.

(9) Foucher. "Excessive Development of Left Arm and Leg." Bull. Soc. Anat. de Paris, 1850, xxx. 98, 108.

(10) Hill, A. "Case of Arrested Development in the Right Fore-arm of . . " Brit.-Am. J. M. and Phys. Sc., Montreal, 1849, v. 119.

CHAPTER V.

CONSTITUTIONAL CAUSES—(Continued.)

NEUROTIC TENDENCIES AS A CAUSE OF ARRESTED AND EXCESSIVE DEVELOPMENT OF THE MAXILLÆ.

Morel, in his discussion of human degeneracy, points out among the evidences of the effect of hereditary defect, abnormalities of the jaws and teeth. These were due to cerebral malformation, and to this Morel ascribes all other structural defects as secondary. These defects have been detected in idiots, congenital epileptics, congenital criminals, congenital paupers, congenital deaf-mutes, the congenital blind (in whom teratological defects produce blindness) and the hereditary lunatics. Although Morel's researches have since the publication of his epoch-making work * been excellently supplemented by the work of his pupils: Magnan † in France, Kraft Ebing ‡ in Germany, Meynert § in Austria, Spitzka || in America and Lombroso ¶ in Italy, still these students have devoted their attention chiefly to the nervous system, and have discussed bodily defects like hare-lip and maxillary malformations only in a very secondary degree. Their researches show that the malformations occurring in the congenitally deficient classes mentioned are the same in origin and result, as the researches of Spitzka and Sutton ** demonstrate, from embryological perturbations producing excess or defect in development or coalescence in function. Hare-lip is a common condition of the second type, as is also the congenital edentate condition of which such striking cases are described by Dr. S. H. Guilford.†† The " Simian diastema " of the anthropologists, found so frequently among the lower races of man by Vogt ‡‡ and others, is another instance of the same kind.

There are other defects due to tropho-neurotic causes such as are active in diseases like paretic dementia,§§ locomotor ataxia, multiple

* Degener. de L'Espece Humaine.

† Les Folies Hereditaires.

‡ Handbuch der Psychiatrie.

§ Jahrbücher f. Psych., Band I. to VI.

|| Somatic Ætiology of Insanity.

¶ Archivio di Psichiatria, I. to IV.

** Comparative Pathology.

†† Dental Cosmos, 1882.

‡‡ Lectures on Man.

§§ Voisin and Mendel on Paretic Dementia.

cerebro-spinal sclerosis. These are pathological in character, while those first mentioned are teratological or developmental. The field of research from an odontological standpoint is a very rich one, but has remained untilled by dental scientists. I have therefore taken the standpoint that the same laws of pathology govern dental pathology and therefore in the following pages I propose to show that the effects of those forms of malnutrition that produce idiocy, deaf and dumbness, and blindness, and the malnutrition that results from over-stimulation of the brain and nervous system of well-endowed individuals, produce similar results, one of the expressions of which is arrest of development and excessive development of the maxillary bones.

It is generally conceded that whatever injures the tissues of the body injures nerve-structures, the latter being more vulnerable than the former. The first of the intrinsic causes of nervous disturbances is *hereditary predisposition,* which may be either *immediate,* that is transmitted from parent to child, *or remote,* being derived either from a grandparent or some more remote ancestor. The latter of these divisions, termed also *reversion,* is common in this class of diseases. An unbalanced nervous system is frequently transmitted, carrying with it a predisposition to various diseases. Ross says, "In such cases the tendency to any particular disease is *indirect* and it is *also general,* inasmuch as one member of the family may suffer from neuralgia, another from chorea, paralysis, hysteria, epilepsy or insanity, while others manifest a tendency to alcoholic excesses."

Recent investigation has also shown a tendency to vice or crime in some cases.

Peculiarities of race are a fruitful source of such disturbances. Where an irritable nervous system exists, which is stimulated constantly by improper modes of living, the tendency to such diseases is increased. Peculiarities of national life and modern life and climate tend in this direction.

The demands of civilized life grow more urgent while the supply of food in proportion to the number of the inhabitants is lessened. Excessive desires necessitate exertion out of proportion to strength. Our form of government, holding out the bare possibility of rising to positions of honor, stimulates effort. Unfortunately, ambition and ability are not always balanced, but often in an inverse ratio, desire for an object being confounded with the ability to obtain it. It thus

finds expression in strife for political aggrandizement, social position, wealth and culture. The path to political position is strewn with physical and moral wrecks, to which occasional newspaper articles and records of physicians call attention. These wrecks are not more frequent among men than the wrecks produced by the strife after social position carried on chiefly by women, the hardships of which, though ridiculed by the press, are borne with a fortitude worthy of a better cause. Late hours, exposure to cold, alcoholic stimulants, opiates and excitement leave traces as disastrous to the human frame as want and toil.

Dr. H. B. Wilbur, in discussing the cause of idiocy, says: "I cannot but regard the majority of cases submitted to my care as less the result of disease or injury than of ill-nourishment of the fetus. Sometimes it is due to the fact that the maternal energy is wasted in other directions, as, for example, exhaustive physical or mental labor, anxiety or even conforming to the unnatural requirements of modern social life." This can be said especially of the mothers among favored classes, whose life is not, as we would expect, carried on mostly at home, giving ample time to the family, but is frittered away largely in what are termed social duties.

That the causes of irregularities seen in our offices belong for the most part to the favored classes all will acknowledge who are engaged in the practice of correction. They are usually young persons of a nervous temperament, of slender build, fair or brown hair and delicate jaws and teeth. In these families the children are usually few in number and deficient in force. These children are often descended from families the earliest generations of which were robust; they were often men and women of great energy and force of character and prided themselves on doing much work. They followed trades or lived an out-door life, or followed the professions. Their habits were simple, but their descendants, on account of an increase of wealth, changed their habits to those of luxury. The toil which gives rise to healthy functions was changed to excitement sought in amusement alternating with indolence. Gaulton, in speaking of energy as a robust virtue and an attribute of the higher races, illustrates the deteriorating effects of indolence by a reference to lower animals. He says: "It is a matter of observation that well-washed and combed domestic pets grow dull; they miss the stimulus of fleas.

7

"The debt that most countries owe to the race of men whom they receive from one another as immigrants, whether leaving their native country of their own free will or as exiles on political or religious grounds, has often been pointed out, and may, I think, be accounted for as follows: The fact of a man having compatriots, or so irritating them that they compel him to go, is fair evidence that either he or they, or both, find that his character is alien to theirs. Exiles are also, on the whole, men of considerable force of character. A quiet man would endure and succumb; he would not have energy enough to transplant himself or to become an object of general attack. We may justly infer from this, that exiles, on the whole, are men of exceptional and energetic natures, and it is especially from such men that new strains are likely to proceed."

Such causes have largely been at work in the settlement of this country. The Puritans, in fleeing from religious persecution, and political and religious exiles of all kinds, formed a large portion of our forefathers. They brought indomitable energy, which left a goodly heritage to their ancestors.

But when, as has been pointed out, wealth requires less expenditure of energy, there is a natural limit to improvement. The causes checking unlimited improvement are, increasing delicacy of constitution, the growing fineness of limb and structure ending in a few generations in fragility. "Overbred animals have little stamina; they resemble in this respect the 'weedy colts' so often reared from first-class racers. One can perhaps see in a general way why this would be so. Each individual is the outcome of a vast number of organic elements of the most varied species, just as some nation might be the outcome of a vast number of castes of individuals, each caste monopolizing a special pursuit. Banish a number of the humbler castes—the bakers, the bricklayers and the smiths—and the nation would soon come to grief. This is what is done in high breeding: certain qualities are bred for, and the rest are diminished as far as possible, but they cannot be dispensed with entirely." Another difficulty lies in the diminished fertility of high bred animals.

The principle of division of labor, however profitable to manufacturer, and apparently beneficial to the employee, robs the latter not only of a wider sphere of action, but stunts his physical powers. Instead of varied healthful labor, one set of nerves and muscles is

constantly called into requisition, while others are restive under enforced inactivity. Irritability of spirit and derangement of organism follow. When women and children are pressed into service things become even worse. The body is enfeebled by bad drainage and bad air, and consumption, scrofula and infective diseases follow. In families that have but lately attained wealth it is desired that the children shall enjoy the fruits of a higher education, and they are consequently subjected to the hot-house pressure of schools where they are supposed to acquire a great variety of subjects. When gifted by nature or coming from families where the brain has been trained for several generations, education is beneficial to the body. Let, however, the boy or girl of ambition and no capacity undertake the same tasks and the results are frequently disastrous. A deplorable tendency to nervous disease is found in those families where for generations scholarship was fostered and where the physique has become weaker with every successive generation until an enfeebled body divests life of pleasure.

All of these results of the high pressure of our civilization striving to dazzle the eye and elicit the admiration of the gaping crowd are disastrous to well-being, failing not only in the desire to gain happiness but losing also some of the good things hitherto possessed. Though disease and enfeebled powers are not apparent in the generations engaging in the race, they are visited upon the members of the one following. There will be occasional cases of idiocy, drunkenness or some other index of feebleness, though the stock may blossom out in an exceptional genius, for the want of balance, which is the prescribed law of nature, is disturbed.

The extrinsic causes of neuropathic conditions are mainly lesions, excessive exertions, exposures, diseases and physical disturbances. Among those of especial interest to us in connection with our subject are exposures, excessive exertion and physical disturbances. These three are a prominent feature in modern life, being the outgrowth of competition and unavoidable in many instances. They are clearly related in their general effects. Exposures are not confined to those who work in the open air, such as drivers and the like. These frequently escape disease by becoming inured to hardships, making them less susceptible to changes of temperature. The man of sedentary habits is more likely to suffer from slight

changes of temperature, because his system is relaxed by overheated rooms and he is exhausted by one-sided exertion.

Exertion not pushed beyond strength is conducive to health; when pushed to excess, as it often must be, it forms a fruitful source of disease The individual that becomes a mere wheel in the machinery of a large concern, cannot help suffering from the constant monotonous tax laid upon him irrespective of his endurance.

It has been conceded for many years that the condition of the nervous system is of the greatest influence on general nutrition. Thus Dr. Johannes Müller, in 1835, makes the following statement:

"In the embryo in which all organic force is still at rest both nerves and organs are produced by the same force. But after organs are produced their constant restoration appears to be dependent on the influence of the nervous system." This reproductive power is proved by the fact that several kinds of animals reproduce certain parts of their bodies, even late in life, when injured. Spiders have the power of reproducing a lost limb before they have attained full growth. The larvæ of insects reproduce their antennæ, but not so the fully developed insect. Crabs reproduce their legs, and fish their fins, and salamanders reproduce their lower jaws. That the nervous system is the agent of reproduction of tissues is further proven by the effect of a disturbance of nervous centres on nutrition. Viering and Langenbuch testify to the influence of the emotions in the healing of wounds. Under powerful agitation they soon assume an ugly appearance. Everybody knows the influence of emotions on the appetite and digestion. Long-continued nervous strain has a morbid influence on nutrition, for whatever disturbs the equilibrium between nutrition and the exercise of the nervous system opens the door to disease. This want of balance results in the deterioration of the osseous system during the period of development, which endangers the subject to irregularities of the teeth. Extensive observation has established the fact that when the brain is weakened by excessive mental labor or disease, it requires a greater amount of phosphoric acid than usual, and this consumption takes place at the expense of the teeth and later on at the expense of the osseous system. It may be asked, Why should the jaws and teeth be affected rather than any other part of the osseous system? They are not more affected, but a slight deviation from the normal attracts more attention to these organs, and the modifications the

contour frequently receives from local causes emphasize these deviations still further. That irregularities do not appear to be common proves nothing. Many are unobserved because they are hidden in the posterior part of the mouth and a still greater proportion are perceived as a part of the face, and are commented upon only when the attention is fixed upon them to the exclusion of other parts. Sometimes an irregularity is regarded as a habit rather than a natural effect, such as vicious anterior occlusion, which is often regarded as a failing to keep the mouth closed, and thus these cases are not presented to the dentist.

We have seen in previous chapters that the stock from which idiots, imbeciles, deaf and dumb and insane spring is tainted with consumption, weak-mindedness, intemperance, syphilis, nervous disorders, and that irregularities are found to a greater extent among these than among persons not defective.

It is equally true that nervous disorders, such as are fostered by an artificial mode of life, increase the tendency to irregularities in offspring.

A comparison of the causes inducing neuropathic tendencies through excessive stimulation and those inducing a defective organism shows them to be analogous in many respects and their results are similar. A result common to both is arrest and excessive development of the jaws, producing irregularities of the teeth.

CHAPTER VI.

FORMS OF IRREGULARITIES RESULTING FROM CONSTITUTIONAL CAUSES.

I. THE V-SHAPED ARCH.

Irregularities of the teeth and jaws resulting from excessive development have been described. It remains now to show how irregularities result from arrested development.

Arrest of development is confined mostly to the upper jaw ; hence V and saddle-shaped arches are more numerous than irregularities of the lower jaw. Local conditions, such as premature extraction of the temporary teeth, causing the first permanent molars to move forward, thus diminishing the size of the jaw, are also the cause of these irregularities.

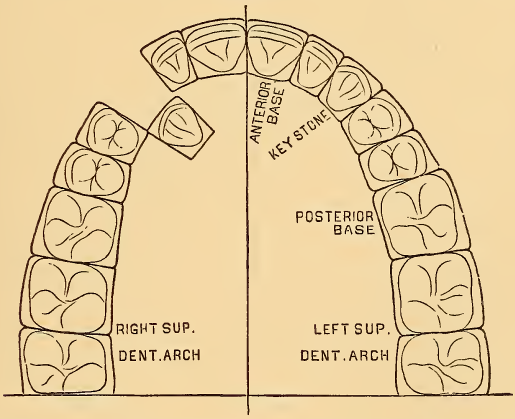
The manner of these formations is as varied as the peculiarities themselves.

It may be well at the outset to state that the only structures involved in the formation of these deformities are the jaws and the alveolar process on the one hand, and the teeth upon the other. The alveolar process is soft and yielding, while the teeth and jaws are composed of hard, unyielding substances. The process adapts itself to the conformation of the teeth. We are taught that the teeth of the superior or inferior maxilla constitute a dental arch, and that the first permanent molars perform the function of keys to the arch. After years of thorough investigation I find that the jaws and teeth, like the lateral halves of the body, develop independently of each other, both possessing their own peculiar characteristics as regards irregularities of the teeth. In order to simplify the classification of irregularities of the teeth I shall call the lateral halves of the jaws, which are separated by the median line, the right and left inferior and the right and left superior dental arches. While these terms as applied to the lateral halves of the maxillary bones are not strictly correct from an architectural point

of view, yet practically (as will be seen) they answer the purposes for which they are employed.

The manner of the formation of the V-shaped arch and kindred deformities may be compared to the construction of an arch of stone. The changes which take place in the movement of the teeth are very similar to those which may occur in a stone arch of faulty construction. Figs. 23, 24, 25 represent one normal arch and five varieties of irregularities of the teeth. Each lateral arch is viewed as containing stones corresponding in number and size with the teeth of a normal upper denture. Fig. 23 represents two arches; the left superior arch is perfect. The first stone is marked "posterior base," and corresponds to the first permanent molar. The second stone is the

Fig. 23.



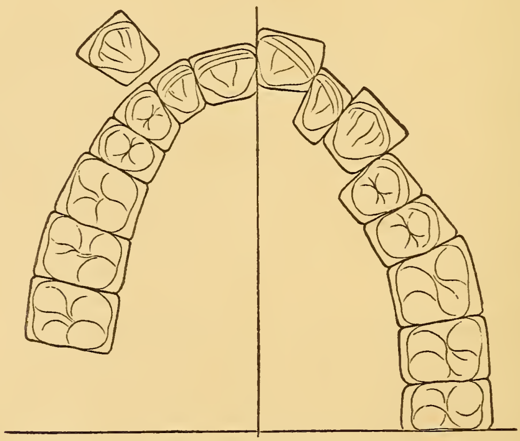
"anterior base;" it corresponds to the central incisor. The next stone is located upon the anterior base and corresponds to the lateral incisor. The succeeding stones are laid upon the posterior base, and represent the first and second bicuspids. The stone corresponding to the first bicuspid is usually in position first, but sometimes the stone corresponding to the second bicuspid is placed first To complete the arch it is necessary to place the "key-stone" in position—the cuspid tooth. If the stones have proper proportions and the measurements are correct, the key-stone will fit into place and the arch will be complete. We shall find on examining the foundations, two more stones, which correspond with the second and third molars; these stones, with the base and the stones above the base, make a strong abutment.

The Normal Arch.

In order that aberrations from the normal may be better understood, let us first consider the question, what constitutes a normal arch.

There are three characteristics of the normal arch. Independent of temperamental peculiarities, the line extending from one cuspid to the other should be an arc of a circle, not an angle or straight line ; the lines from the cuspids to the third molar should be straight, curving neither in nor out, the sides not approximating parallel lines. Absolute bilateral uniformity is not implied in this, as the two sides of the human jaw are rarely if ever wholly alike. A uniform arch necessitates a uniformity of development between the

Fig. 24.



arch of the maxilla and the arch of the teeth, and a correct position of the individual teeth in their relation to each other. When there is inharmony of development between the jaw and the teeth, as may happen when one parent has a small maxilla with correspondingly small teeth, and the other a large one with correspondingly large teeth, if the child inherits the jaw of one and the teeth of the other, irregularities must follow. Such difference in diameter between the arch of the maxilla and that of the crowns of the teeth is a constitutional cause of irregularity.

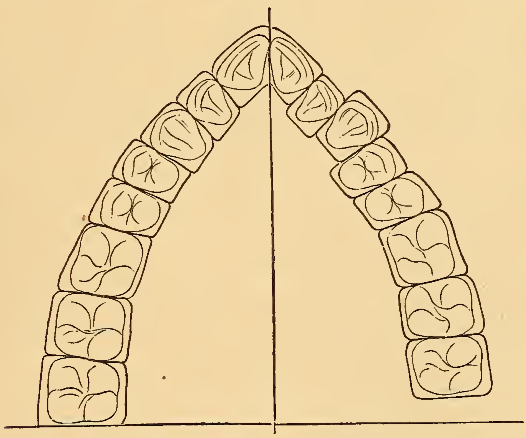
Whenever there is a difference between these diameters, the line formed by the teeth must either fall outside or within the arch of the maxilla, and irregularities of arrangement result.

FORMATION OF THE V-SHAPED ARCH.

In Fig. 23 the right superior arch shows the diameter of the stones to be either two small for the curve of the arch, or that the bases were set too far apart for the curve of the arch. This results in a greater space for the key-stone than is required, and not finding support it drops through towards the centre line.

In Fig. 24 the right superior arch shows that the posterior base and the foundation stones have been brought forward to such an extent that when the other stones are placed in position, the space intended for the key-stone is entirely closed and the key-stone remains outside the arch. The left superior arch appears as though the key stone were too heavy for the arch, and its weight has

FIG. 25.



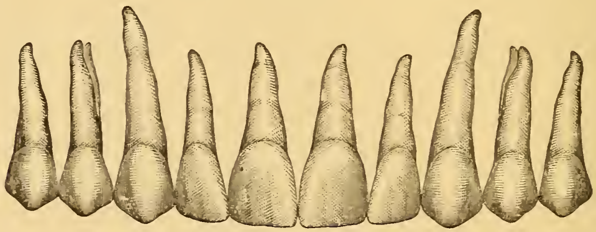
carried the smaller stones with it. The posterior base with its foundation stones, being the strongest, resists the force; the anterior base being weak and without support, bulges out, and in this way a semi-V-shaped arch is produced.

Fig. 25 illustrates the V-shaped arch. The right superior arch shows that the key-stone has gradually carried the arch inward; the posterior base is in its proper position, the anterior base has been carried forward, and all the stones are in line. The key-stone in the left superior arch has produced the same result as upon the opposite side, excepting that the posterior base and the foundation stones were placed too far forward, leaving insufficient space for the key-stone. The teeth, however, do not bear the same relation to

one another upon their approximal surfaces that the stones of the arches do. The stones of an arch have broad, flat surfaces, while the teeth touch merely upon the points of rounded surfaces.

The ten anterior teeth which are involved in the construction of the V-shaped and kindred irregularities, are illustrated in Fig. 26, in which the positions of the roots and crowns, and their mutual relations, are approximately shown. As will be observed, the teeth are all wedge-shaped, the bases being located near the cutting and grinding-edges and the apices at the ends of the roots. These are

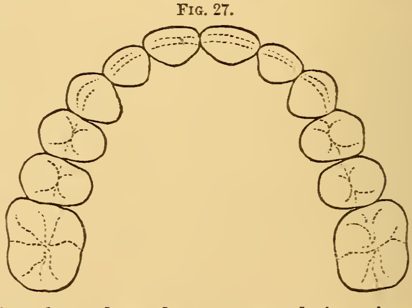
FIG. 26.



nearly round and conical, the points of antagonism being near or quite at the cutting or grinding-edges. Fig. 27 shows a section of the teeth at their points of contact. These points must be kept in mind, as they constitute the fulcra of the levers, which, when force is applied to the teeth, cause them to rotate and move out of position, thus producing a greater variety of deformities than it is possible to demonstrate upon the stone arch.

As has been previously mentioned, these irregularities are not observed until after the eruption of the second set of teeth. We shall therefore first consider the first permanent molars. These teeth are the largest, strongest, and possess the largest roots of any of the teeth. They are located posteriorly to the temporary set. Owing to their position and to the fact that they have long, large roots, their apices are directed backwards, and, in a majority of cases, the distance from the apex of one root to that of another is greater than at the

FIG. 27.



neck, which fact indicates that they are firmly fixed in their alveoli. The alveolar process is wide at those points; these teeth therefore would naturally be designated as the posterior bases of the lateral arches.

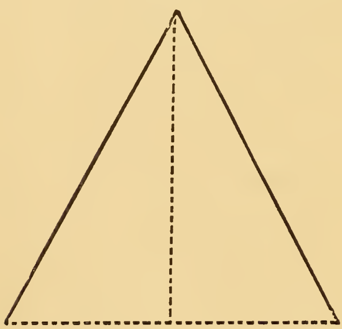
The next teeth which make their appearance are the central incisors. These are situated in the extreme anterior alveolar process on either side of the median line, and the process is quite thin at these points. These teeth will be called the anterior bases of the lateral arches. The next to make their appearance are the lateral incisors, which take positions at the distal surfaces of the central incisors. The roots of these teeth are not so large nor so long as the roots of the centrals; therefore they are not as firmly fixed in the alveoli. Each lateral tooth, however, is supported by the central, and represents the second stone upon the anterior base. The teeth which next appear are the first bicuspids. Immediately following are the second bicuspids, which represent the second and third stones upon the posterior bases. The arches are then complete, except the key-stones—the cuspid teeth. These cannot be omitted, for they bind and hold the teeth together and give beauty and shape to the arches. The follicles of these teeth are originally situated outside of and above the crown and roots of the teeth already in the arch, which results in a larger circle; and because these teeth have long, powerful roots, unusual power and leverage is given them. For this reason they are directed downward and inward, their crowns being so located that the lips assist greatly in aiding the downward movement of these teeth. The downward and inward movement of the cuspids is similar to the lowering of the key stone in an arch; it continues to move downward until it meets with an obstruction, which may be confined to the upper jaw and include the teeth anterior and posterior to the cuspid. If the teeth in position are in harmony with the jaw, the cuspids will descend into their proper places and, touching the teeth on each side, lock the arches and hold the teeth in proper position.

Let us examine the arches with their bony encasements, and ascertain what the bases are resting upon, the relative strength and support of each base, and the relative strength of the anterior and posterior columns. In the posterior parts of the mouth the alveolar process is very thick, and the base—the first permanent molar—is large, having three roots in the upper jaw and two in the lower,

curved and so arranged in the alveolar process as to preclude its going backward. We also find other teeth of nearly equal strength posterior to the first permanent molars. Anterior to the base—the first permanent molar—we find the first and second bicuspids; these teeth are all firmly imbedded and situated in the long axes of the alveolar process, forming together a very firm base. The anterior column of the arch consists of but two teeth, while the posterior column has five. The anterior teeth possess single roots, and are situated crosswise in a very thin alveolar process, thus demonstrating the comparative weakness of the anterior arch. In some instances the space may be too large in the superior arch, and the key-stone or cuspid tooth may continue in its downward course till it engages with the teeth in the lower jaw.

Description of the V-shaped Arch and its Modifications.

Fig. 28.



The V-shaped arch presents a triangular outline, Fig. 28, the apex of the triangle being formed by the central incisors where the process is *usually* bent so that the incisors form an angle instead of being in line. From this apex the lateral halves are in a straight line terminating at the first molars; a line connecting them forms the base of the triangle. The cause of this peculiar outline is a want of correspondence between the size of the jaw and teeth, or the premature extraction of the temporary molar, or both causes combined, thus allowing the first permanent molars to move forward. When the rest of the permanent teeth come in they do not find room and are thus crowded together; the process must give way in order to adapt the greater arch formed by the crowns of the teeth to the lesser arch of the maxilla. The point of fracture is in or near the median line, since the process is thinnest at this point. The illustrations given here show varieties of this type. By comparing each one with the diagram it will be seen that they all are triangular in outline, (Fig. 28c) being the best representation of this form of irregularities. A line passing from the median line of the central

Fig. 28-A.

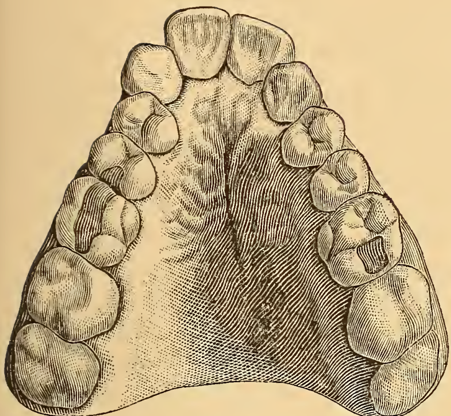


Fig. 28-B.

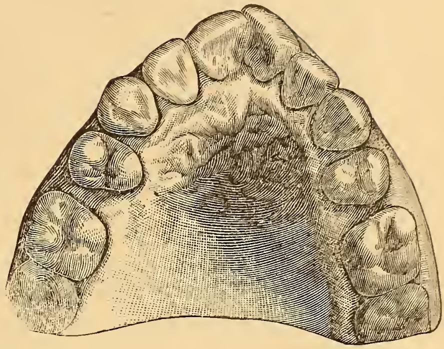


Fig. 28-C

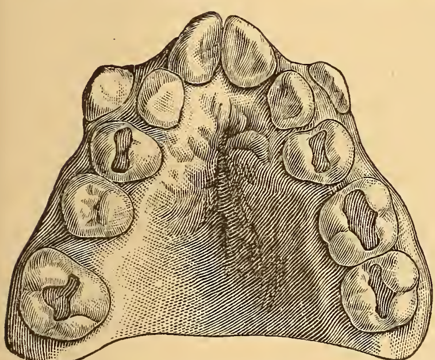
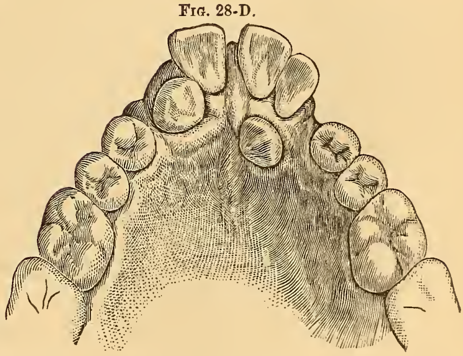


Fig. 28-D.



incisors through the cutting edges and crowns is straight. The study of the cases here given shows the result of the forward movement of the first molar. The subsequent loss of teeth, the peculiarity of articulation, and the thinness of the process at certain points determine the modifications. In Fig. 28-A it will be noticed the laterals are gone; for this reason the centrals are still in line, space having been made by the absence of the laterals; Fig. 28-B shows by its overlapping centrals that there was want of space at the time of their eruption; the loss of the second bicuspids subsequently, together with peculiarities of articulation, have permitted the lateral halves to assume some curvature. Fig. 28-C shows an arch too small for the teeth and is destitute of the right first molar

and the left first bicuspid. These were evidently lost after the central incisors were erupted. The rest of the teeth have migrated more or less because not kept in place by close articulation. Thus the cuspids are kept out of place, and by their pressure inward tend still more to narrow the arch anteriorly. In Fig. 28-D the centrals are spread, though the process is evidently bent. This spreading is accounted for by the absence of the right lateral, which has allowed the central to move backward and the cuspid to move in. On the left side we see the cuspid erupted inside of the arch.

Modifications of the V-shaped arch result from modifications of the above-named conditions. A difference in the time of eruption of the cuspids, everything else being equal, effects a difference in the space left for their accommodation, and thus partial V-shaped arches are found. The key-stone, the cuspid, is not entirely outside or inside of the arch in the partial V-shaped form, but may appear partially crowded out of place. Hence the arch is neither a normal curve nor wholly angular, but unites the characteristics of both. Its lateral diameter is less than that of the normal arch, giving it a contracted appearance. (See Fig. 29.) Thus a number of varieties of the fundamental forms of the V-shaped arch are formed, differing in degrees of anterior contraction. All of these result from the comparative thinness of the anterior portion of the process offering but little resistance, an abnormal pressure from behind, and the greater strength of the cuspids, which causes them to seek room irrespective of the space left for them. By drawing a perpendicular line from the median line of the central incisors to the base, and comparing the halves thus obtained with our diagram, we see that the right half in Fig. 29-A is partially V-shaped, while the left is normal. Near the apex we have the crowded condition of the incisor, overlapping the lateral; from thence back the curve of the arch is lost. The absence of the first bicuspid, together with the want of proper articulation, has allowed the cuspid to press nearer the centre of the palate than is normal.

In Fig. 29-B the V-shape is not so apparent, but the central incisors are crowded, which shows that there is not perfect harmony between size of teeth and jaw. This contracts the anterior arch.

When one side of the process near the symphysis is the stronger, thus affording greater resistance, or the pressure of the cuspid is less, that side may maintain its normal relations while the other may

Fig. 29.

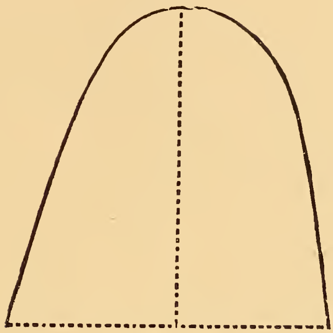


Fig 29-A.

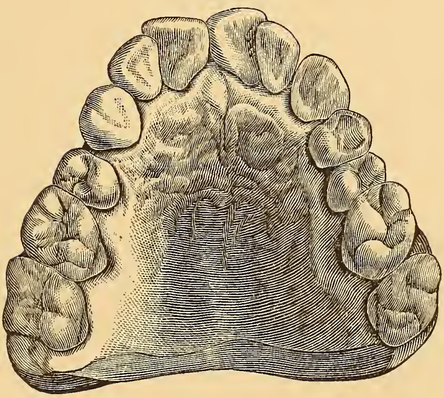
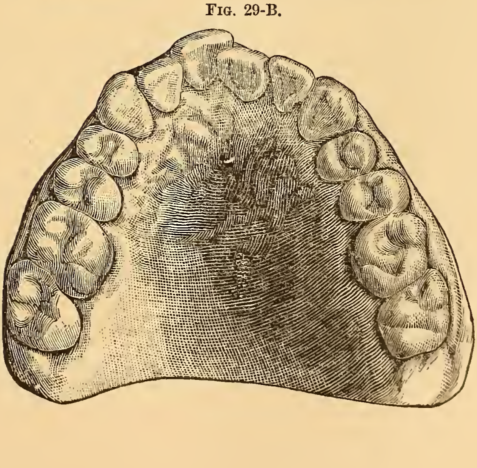


Fig. 29-B.



give way to conditions resulting in a V-shaped contraction. The curve will then be broken, not at the apex of the triangle, but near it; the incisors will overlap and when pressure from the cuspid acts on the weaker column it must give way. This results in the semi-V-shaped form. (Fig. 30.)

Fig. 30A illustrates a semi-V-shaped arch. The teeth in the left dental arch are nearly on a straight line. The teeth in the right dental arch are situated upon a slight curve. In this arch the cuspid is in position, while upon the left arch it is missing. The posterior teeth have moved forward and filled the space intended for the cuspid. It is still located in the alveolar process, and the force produced by the inward pressure of the cuspid is so great that the central and lateral incisors have been carried forward and the teeth and alveolar process have produced the straight line. The lateral pressure of the teeth prevents their being carried farther inward. The lack of proper antagonism of the central incisors has allowed the cuspid to force the incisor and alveolar process forward until the basilar ridge of the right central antagonizes with the mesial surface of the left central This, in a measure, checks the progress of the cuspid inward and holds the arch on a slight curve. A perpendicular line drawn from the mesial surface of the right central incisor Fig. 30-B to the base shows the left side to be V-shaped, while the right is normal. In Fig. 30 C the outline does not so clearly point to a V-shaped arch. By comparing the curvature of the two halves and noting the position of the right cuspid, it is more apparent. The bending of the process at the mesial line is evident from the position of the right central. This has turned upon its axis from want of lateral antagonism and proper occlusion. This partial rotation has allowed the lateral to move back, occupying in part the space of the cuspid which has forced the cuspid out of its normal position, causing it to erupt outside of the arch.

Fig. 30-D shows a combination of semi-V and partial V-shaped arches. The cuspid being outside of the left arch contracts it and gives it the characteristics of the V-shape. On the right side the cuspid is partially crowded out of place, and the arch is somewhat contracted.

Fig. 30.

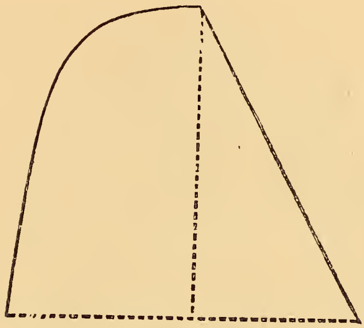


Fig 30-A.

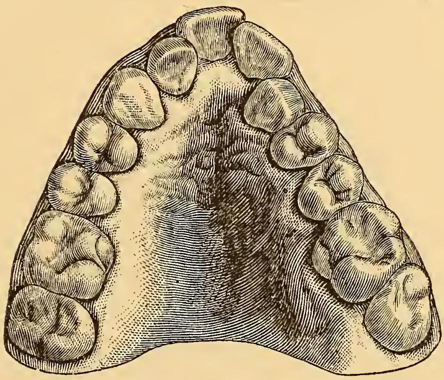


Fig 30-B.

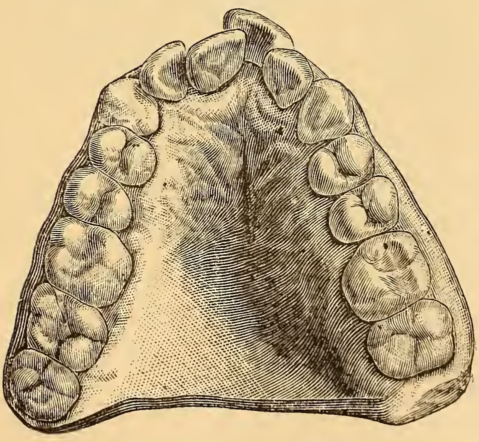


FIG. 30-C.

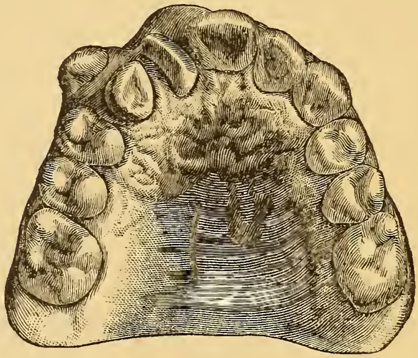


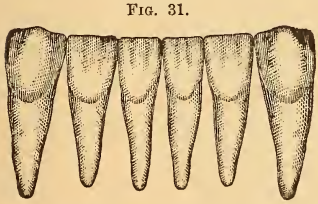
FIG. 30-D.

IRREGULARITIES OF THE LOWER JAW.

The lower jaw never assumes the V-shape when the teeth articulate normally, because the anterior inferior teeth normally close inside of the upper teeth, and, while the force from improper occlusion of the jaws and the forward movement of the posterior lower teeth is as great or greater than the like force exerted upon the upper jaw, the forward movement of the central incisors is prevented by the striking of their anterior surfaces against the posterior surfaces of the superior incisors. There are many irregularities of the anterior inferior teeth caused by the forward pressure of

the posterior teeth. These are quite difficult to regulate, owing to their intimate relations with the superior incisors. The inferior dental arch should be divided into the right and left lateral arches, corresponding to those of the superior arch. The pressure produced by improper articulation and the forward movement of the posterior columns (the bicuspids and molars) is exerted on each lateral half independently, like that in the lateral arches of the upper jaw. Each lateral arch on the lower jaw has its posterior base (the first permanent molar), an anterior base (the central incisor), and the same number of stones in position upon the bases,—the same key-stone,—all representing the same number of teeth as are contained in the superior lateral arches. The development of each inferior lateral arch is independent of the other, as is the case with the superior lateral arches. The irregularities of the teeth in each lateral arch are independent of the others. When the posterior column moves forward, if the key-stone (the cuspid tooth) is retarded or slow in coming into place, the space is filled by the first bicuspid and the cuspid remains outside, precisely as in the superior lateral arches. If the pressure of the posterior columns and the key-stone is uniform, the force will be exerted against the anterior base and the first stone upon the base (the central and lateral incisor). In this case a different condition exists. The anterior base and first stone of the superior lateral arch, and the anterior inferior column, resist the force. Occasionally, this is so great that the anterior columns of both superior and inferior dental arches are carried forward. When this occurs, the incisors upon the upper jaw protrude. When the forward movement of the posterior column occurs, the incisor (or anterior column) will crowd past one another like the sticks of a fan, provided the pressure be uniform in both lateral arches. The six teeth which are instrumental in the construction of these deformities are illustrated in Fig. 31. These teeth, as will be observed, are wedge-shaped; their points of contact are at their cutting edges; slight oblique pressure will cause these teeth to lap over each other. If the pressure is upon one side only, the irregularity will be located on that side. One of the common irregularities is seen when the key-stone or cuspid tooth is slow in erupting. The

Fig. 31.

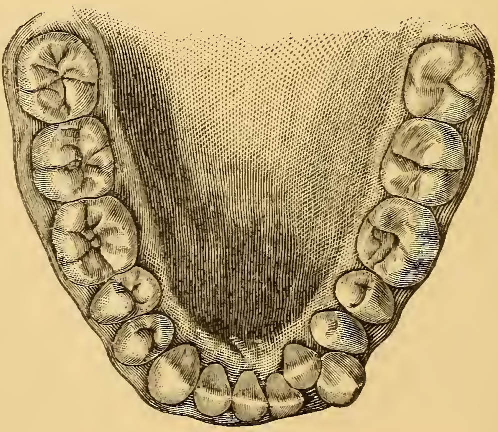


posterior column moves forward and the resistance of the anterior column forces the key-stone outside the arch. It sometimes happens that the key-stone moves into place and is held in position by the anterior column, and the second stone upon the posterior column (the first bicuspid) is carried forward outside the arch. This theory can be better understood by examining cases of this kind which are

FIG 32.

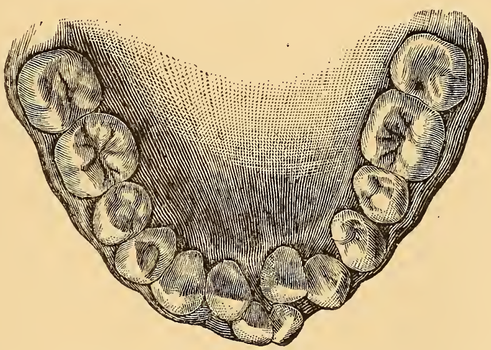
found in my models of the jaws and teeth, and which will be illustrated later. It may be well first to glance at Fig. 32, which shows in position a section of the teeth made on the line of lateral antagonisms. It will be observed that the mesial and distal surfaces are convex, and the points of contact are situated at the extreme lateral surfaces. If the teeth at eruption should not touch at these particular points, or if the force exerted should not be in direct line with these points of contact, the teeth would be situated upon an incline, and the force thus applied would readily carry the teeth one way or

FIG. 33.



the other. Such deformities occur more frequently with the incisor and cuspid than with the posterior teeth. The posterior teeth are held in position by their contact with the occluding teeth of the opposite jaw, while the incisors do not occlude. One marked feature of these irregularities is that in most cases the lateral incisor is carried inward and the centrals outward to remain in position in one or both lateral arches. These conditions are fully illustrated in the chapter on local causes. Fig. 33 shows the right dental arch as normal. In the left dental arch the anterior column with the cuspid (the key-stone) has moved forward, and the lateral incisor is carried inward. This is explained when the relation between the mesial surface of the cuspid and the distal surface of the lateral is understood. In the forward movement of the cuspid the lateral impinges upon a markedly inclined plane upon the mesial surface of the cuspid, and the forward pressure carries the lateral inward. Fig. 34 shows the same irregularity in both right and left lateral arches, the

Fig. 34.



pressure being uniform upon each arch. The centrals are also slightly rotated in their sockets. This is produced by the flat lateral surfaces of the roots meeting and the pressure of the crowns against the basilar ridges of the superior centrals.

CHAPTER VII.

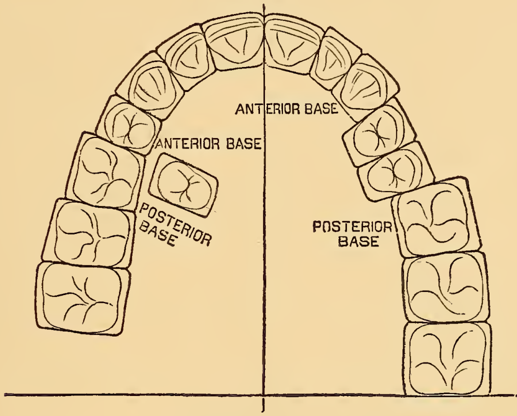
FORMS OF IRREGULARITIES RESULTING FROM CONSTITUTIONAL CAUSES (Continued).

II. THE SADDLE-SHAPED ARCH.

The saddle-shaped arch is not so common a deformity as the V-shaped. It has many of the peculiarities, however, that are seen in the V-shaped arch. It may include one or both lateral arches. It may be partial on one side and marked upon the other. It may involve the bicuspids and first permanent molars upon one side, or but a single tooth on the other. Each lateral arch produces its own deformity independently of the other. The roof of the mouth may be high or low. The deformity, like the V-shaped arch, is favored by the high arch. The following illustration (Fig. 35) shows the manner of the production of this deformity. We see here a right and left superior lateral arch of stone, each stone corresponding in size and location to the natural teeth. The left lateral stone arch, corresponding to the left superior dental arch, shows the formation of the saddle-shaped arch and the order of laying the stones and changing the base. The first stone laid in the arch corresponds to the first permanent molar, and, like the stone in the V-shaped arch, is denominated the posterior base. The next stone laid corresponds to the central incisor, then the stone which stands for the lateral incisor. The natural order then changes, and the next stone laid corresponds to the key-stone of the V-shaped arch (the cuspid). It becomes the anterior base, forming a fixed point in the anterior part of the mouth. The next stone laid corresponds to the first bicuspid, followed by those representing the second bicuspid and the second and third molars. The stones being in position, we find that the anterior and posterior columns are nearly equal in strength and resisting power. The anterior column is made up of the anterior base (the cuspid), with its long root, backed up by two foundation-stones representing the central and lateral incisors. The posterior column is made up of its base, the first permanent molar backed by two foundation stones, representing the second and third molars.

The forward movement of the posterior column takes place in the arch from the same causes which produce the forward movement in the V-shaped arch. The stone representing the cuspid is not the stone involved; it is almost always fixed in its proper place. The weaker stones are those which correspond to the bicuspids, and they

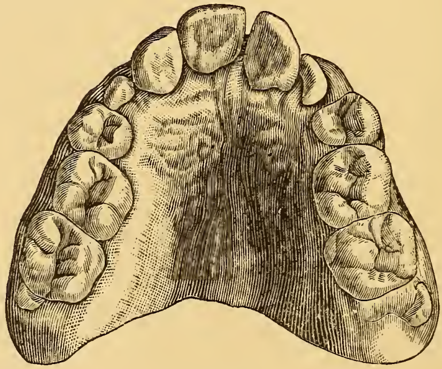
FIG. 35.



are the stones which are always displaced when the forward movement of the posterior column occurs. The change in the order of the laying of the stones—*i. e.*, the stones corresponding to the cuspid instead of the bicuspid (it being irregular)—accounts for there being fewer saddle than V-shaped arches. The change of the anterior base will also explain why the anterior column and alveolar process do not project, as in the case of the V-shaped arch. The right superior lateral arch illustrates another common variety of the saddle-shaped arch. It does not differ materially from the left lateral arch as regards the order of laying the stones. The anterior base is transferred one stone back, the stone corresponding to the first bicuspid. The posterior base remains the same. The posterior column moves forward and carries the stone representing the second bicuspid inward. By comparing the shapes of the natural teeth with the stones in the arch just described, we shall observe that the approximate surfaces are convex instead of flat like those of the stone arch just described. The peculiar incline of the anterior surface of the first permanent molar and the posterior surface of the cuspid tooth, together with the oval shapes of the bicuspids, are

singularly well adapted to cause these irregularities upon the application of force. The first permanent molars are situated farther outside in the arch than any teeth posterior to them. The cuspids occupying such a prominent position in the arch, in the anterior part of the mouth, the least deviation inward of the bicuspids would give the pinched appearance of the jaw at that locality. This deformity is caused also by the too early extraction of temporary molars, which allows the first permanent molars to work forward and force the bicuspids inward, or by the retention of the temporary molars or their roots, thus deflecting the crowns of the bicuspids. The question arises, Why are not the bicuspids forced outward as well as inward? I would reply that they do occur frequently outside the arch: I have several among my collection of models. The inward movement, however, is the natural one, because the crowns when in the jaw are situated between the roots of the temporary molars. The temporary molars are situated upon a smaller circle than the permanent molars and cuspids (see Fig. 36). When the temporary

Fig. 36.



molars are extracted, the crowns of the bicuspids are in the radius of a smaller circle, while their roots have been carried outward by the development of the jaw and alveolar process.

The molars in the saddle and semi-saddle-shaped arches of the upper jaw frequently diverge laterally. If the case shows a semi-saddle-shaped arch, the divergence is on the side of the deformity. If both lateral arches are involved, both sides diverge. Cases having the deformity most prominently have the most marked divergence.

When a slight change exists only at the bicuspid region, the divergence in the molar region is slight. This peculiar arrangement of the molar teeth may be due to two causes. First, the teeth upon the lower jaw diverge on account of the shape of the inferior maxilla; the farther removed from the incisors, the greater the distance between the molars of the opposite side. The molars upon the upper jaw usually articulate with those upon the lower jaw. The disparity in the appearance of the normal position of the teeth and those above described is due to the pinched condition in the bicuspid and first molar region rather than to the position of the molars. Second, when the arch is contracted at the bicuspid region the tongue is limited in its movements. In swallowing, the tongue goes to the roof of the mouth and is then forced backward for lack of room, thus shortening and consequently broadening its surface. The result

FIG. 37.

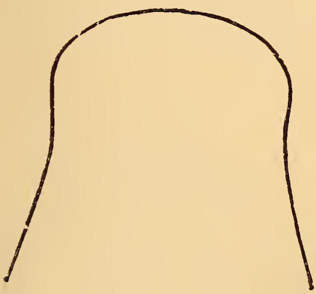


FIG. 37-A.

of the lateral expansion would naturally be to force the teeth and alveolar process outward.

The position of the temporary molars determines the position of the bicuspids. This position shows the diameter of the jaw early in life. From that time until the eruption of the third molar, *i. e.*, from the third to the twentieth year—the jaw has an opportunity to develop, which naturally carries the alveolar process and teeth out laterally, causing the crowns of the third molar to face the cheek in some instances.

Description of the Saddle-Shaped Arch and its Modifications.

When there is harmony between the size of the teeth and that of the arch, and the permanent bicuspids erupt under favorable conditions, so that their greatest diameter is in a line with the greatest diameter of both cuspid and first molar, they will be held firmly in place, since the greatest pressure is on this very line. On the other hand, when the bicuspids are erupted *after* their proper time, while the cuspids progress duly, the cuspids, meeting with no resistance, fall into their natural position, while the bicuspids erupt inside of the arch, forming an angle. This angle results from two causes,—the thinness of the process at this point and the diminution of resistance which must follow.

Fig. 37-A shows a decided saddle-shaped arch. The maxillary bone is too narrow at its anterior extremity for the teeth, which are suited to a more expanded jaw. The constitutional tendency to this deformity is quite apparent in this case. The vault is high and narrow. The first molars are pushed forward, leaving only sufficient space on each side for one bicuspid. These are therefore turned inward toward the palate, making the vault at this point still narrower than it naturally is.

Fig. 38.

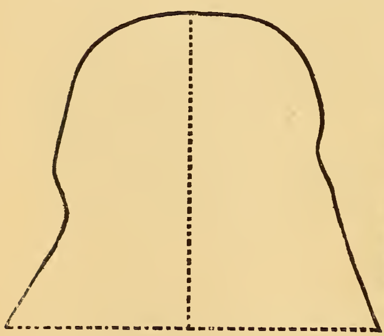
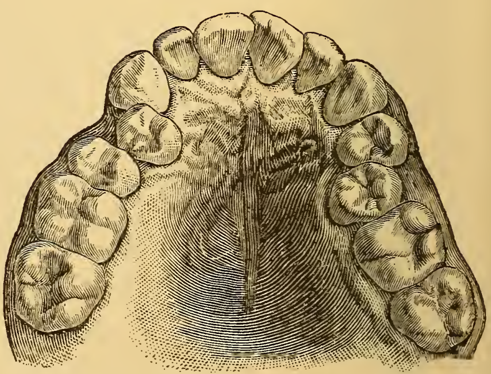


Fig. 38-A.



When the unfavorable conditions that result in the saddle-shaped arch are not so pronounced, we have the partial saddle-shaped arch. Thus, because of the greater uniformity of the maxilla and of the arch of the crowns there may be more space, and the bicuspids may be forced but little out of place, or the molar may move forward but

slightly, interfering less with the bicuspids. Sometimes it happens that in trying to adjust themselves to the limited space one bicuspid may be crowded outward and another inward. Sometimes the first bicuspid is in, more frequently the second. (Fig. 38-A).

FIG. 39.

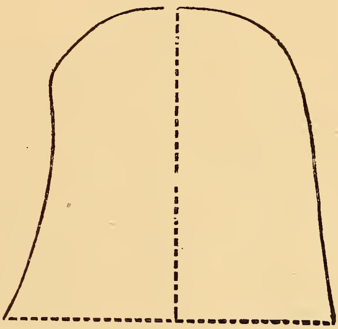


Fig. 39-A shows a normal arch on the left side, and a saddle-shaped arch on the right. The vault is normal in this case; hence

FIG. 39-A.

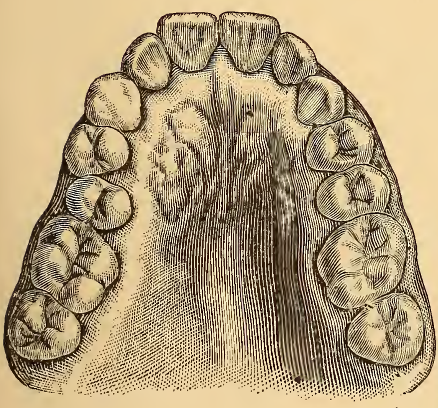
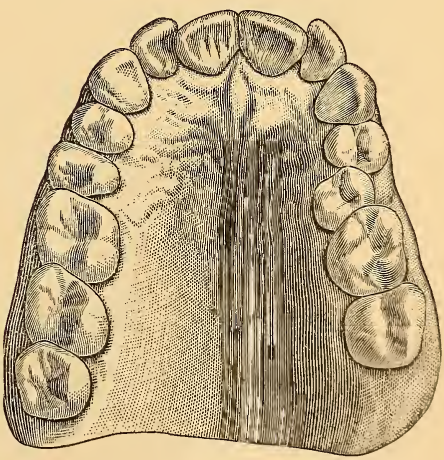


FIG. 39-B.



there is more room for the erupting bicuspids, and less curvature results than is found in Fig. 38-A. Fig. 39-B shows a similar condition of the left side.

Combination of V and Saddle-Shaped Arches.

How the V-shaped and saddle-shaped arch on one side only may be produced has already been described. How they may be combined on one side remains to be explained. Given thinness of process in the anterior part of the mouth, premature or tardy extraction

Fig. 40.

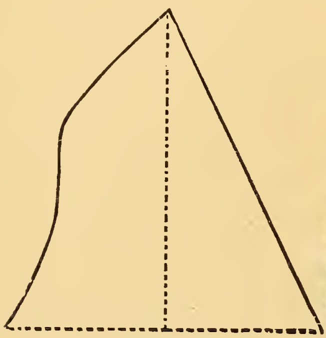
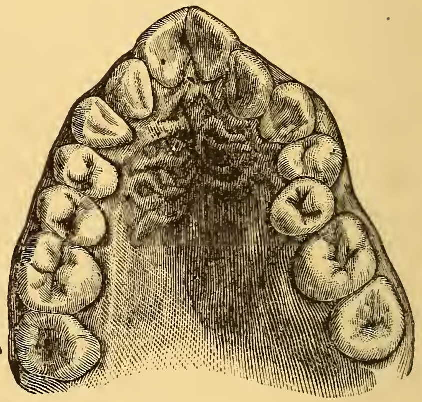


Fig. 40-A.



of the first molar, and there will be a forward movement of the incisors. The development of the cuspid will press the alveolar process inward, thereby contracting the arch, and the tardily

Fig. 41.

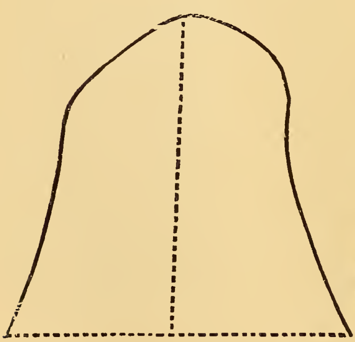
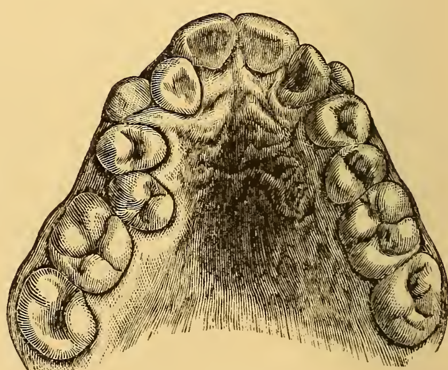


Fig. 41-A.

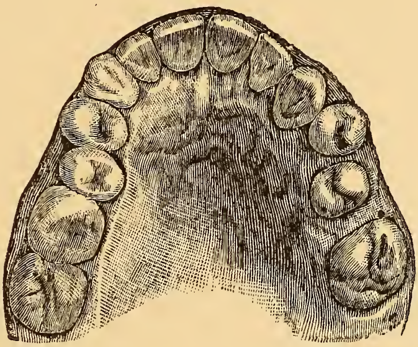


erupted bicuspids will adjust themselves to the limited curve as before stated. In this way the features of the two forms are com-

bined; that is, a contracted or angular anterior arch, and a posterior arch that is more or less concave. The opposite side may be V-shaped, saddle-shaped or normal. (Figs. 40 and 41.)

Fig. 40-A shows a combination of V and saddle-shaped arch on the

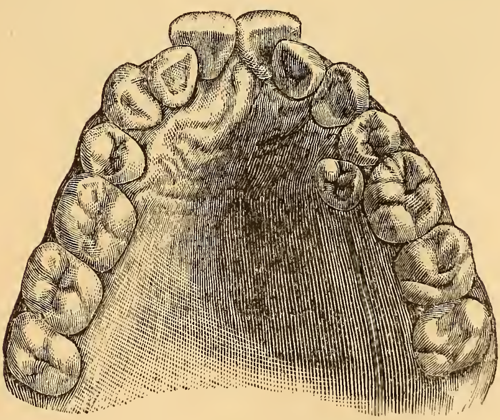
Fig. 42.



left side and V-shaped on the right. Fig. 41-A is a case of semi-V and semi-saddle-shaped arches combined.

Fig. 42 shows a semi-saddle shape in the right lateral arch, the second bicuspid has been forced inside the arch. The opposite side

Fig. 43.



shows a condition exactly reversed. The points of lateral antagonism of the second bicuspid are outside the long diameter of the dental arch. The anterior movement of the posterior base forced the

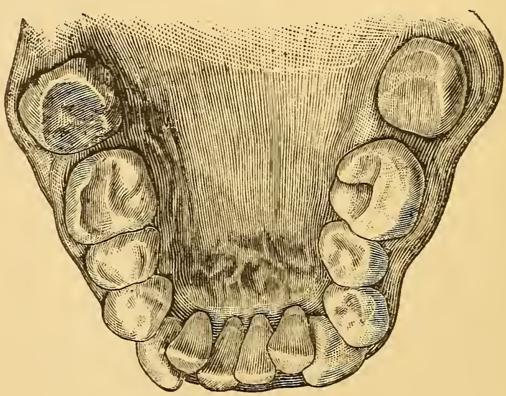
tooth outward. The tendency of this irregularity was to form the V-shaped variety. The irregularity of the left lateral arch (Fig. 43) is a common one. The teeth develop normally, but the second bicuspid is either retarded in its development or it is deflected inward by some local cause. The anterior base is, in this case transferred to the first bicuspid. The posterior and anterior bases come together, and the second bicuspid is crowded inward. This irregularity corresponds to the right lateral stone arch of Fig. 35.

The Saddle-Shaped Arch of the Lower Teeth.

The saddle-shaped arch on the lower jaw is generally due to local causes, the retention of the temporary molars being one of them. The one illustrated is the result of both local and constitutional causes.

Fig. 44 illustrates a saddle-shaped irregularity upon the lower jaw. The impression is from the jaw of a man fifty-six years of age; the second molars were extracted at the age of twenty-two. The irregularity was produced at the time of the development of the teeth.

Fig. 44.



The teeth are large and firmly set in the powerful jaws. Asymmetry of the jaws exists. If they had developed in unison, this deformity would have been prevented. The forward movements of the posterior columns have carried the cuspids forward and the lateral incisors inward, so that the cuspids and centrals stand on a line. The second bicuspids and first permanent molars have

been forced inward by the inclined plane formed by the posterior surfaces of the first bicuspids, and also by the articulation of the superior teeth, which form a smaller arch than the lower teeth. As will be seen, the third molars have moved forward and nearly filled the spaces made vacant by the extraction of the second molars. This forward movement was no doubt due to improper articulation with the upper teeth.

CHAPTER VIII.

LOCAL CAUSES.

A LOCAL cause resulting in an irregularity is found in malposition and malocclusion of individual teeth as a result of an accident, such as premature or tardy extraction of temporary teeth, or malposition and malocclusion growing out of constitutional causes.

Before taking up each form of the irregularity to which an individual tooth is subject, a few words should be said about the relative influence and force of teeth, for on this these irregularities in a great measure depend.

Relative Importance of Individual Teeth in Effecting Irregularities.

Foremost in influence on the relative position of permanent teeth is the first molar. If the temporary molar is extracted prematurely the forward movement of the posterior column follows it, the expanse of the anterior column producing more or less vicious position, relation and occlusion. I have frequently observed the anterior movement of the temporary molars and cuspids as well as the permanent bicuspids and cuspids, from the great force exerted by the first permanent molar, and have a number of models showing same. To this even the cuspid must yield, though most influential in the anterior column. Next to the first permanent molar in importance is the cuspid. It asserts itself above the rest because of its vital force, length of root and peculiar shape. The length of its root allows it to deviate more than any other tooth from its original position, because, with the same degree of pressure brought to bear on or near the apex of its root, a tooth may diverge in proportion to the length of its root; though the angle is the same, the divergence grows greater the farther the cusp is from the apex.

The central incisor comes next in importance, and then the lateral. The central incisor finds a support in its fellow on the opposite side, while the lateral is the most passive of teeth. It, however, plays the part of a co-ordinating force, since without this wedge the teeth are

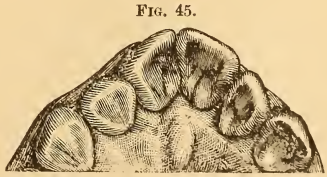
not retained in their position, and occlusion is disturbed. Because of its weakness and short root it is very easily displaced.

THE CENTRAL INCISOR.

Irregularities Produced by the Malposition of Central Incisors Resulting from Flexion of the Alveolar Process.

I. In the chapter on general classes of irregularities the fact was emphasized that the forward movement of the posterior column—*i e.*, the bicuspids and molars due to premature or tardy extraction—will force the weaker anterior column and alveolar process forward. The pressure brought to bear upon it from both sides makes the arch of the upper maxilla greater than that of the lower. As a consequence occlusion will be wanting or defective and flexion must take place according to the position assumed in the eruption of each individual tooth. This condition is greatly promoted by the pressure of the cuspids, which, in coming down, assert themselves at the expense of the weaker incisors. But this is not all. Much depends on the size and the development of the germs of the permanent incisors. When there is strong vitality their size may be out of proportion to that of the alveolar process. Owing to healthy nutrition or the nature of the food that is taken into the system during the time of their development, the centrals may become very vigorous. This more than ordinary development shows itself not so much in the relative position of the axes, but in the irregularities of the cutting edges owing to the excessive diameters of these, which causes them to overlap slightly. When a temporary incisor persists too long in its socket, the germ of the permanent tooth is embarrassed in its eruption. The germ seeks its way out as best it can, and as projecting in a straight line is out of the question, it slips around the temporary teeth and is forced partially out of position. The process in this case is not unlike that of the germ of a plant that forces its way out from under a stone.

Fig. 45.

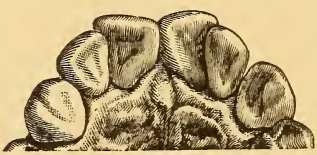


(*a*) Having considered the cause of the irregularities of this division, we will now proceed to consider its varieties. A form frequently met with is found in V-shaped arches. The central incisors are crowded together so that their cutting edges are not in a line, but form an

angle that points forward. (Fig. 45.) This is the most natural form for the flexion to assume. The arch is simply broken in front, following the the general direction of the pressure. The mesial surfaces are parallel; the anterior angle points forward, following the general law of incisors. The force is uniform. Had the anterior column not been forced forward by the posterior one, these teeth would be normal in every respect. Sometimes we find them overlapping each other slightly, and occasionally the anomaly is met with that the general axes of the teeth do not converge, but diverge. This divergence is found to be due to a faulty occlusion, the lower incisors acting as a wedge driving the upper incisors apart, or else, from a want of occlusion, they follow their course without guidance and support.

(*b*) In the second class, where the cutting edges form an angle which is directed backward (Fig. 46), the pressure from behind by the posterior column has met with an obstruction in front. This obstruction exists in the centre of the alveolar process, and is strong enough to resist in a measure the pressure from behind. Hence the force spreads itself on the lateral divisions of the anterior process. The result is that the mesial line is formed behind the distal line, and an angle is formed. Here, as in the former case, occlusion is an important factor in determining the position of the axis. A want of proper occlusion may force the anterior teeth apart. The laterals also in seeking their natural position may help to force the distal surfaces of the central incisors still more out of line. Being wedged in between centrals and the cuspid teeth, the latter, by their greater force, cause the centrals to yield to the laterals that are wedged between them. The mesial angle of the laterals infringes upon the inner surface of the distal angle of the centrals. These continue to rotate until the entire mesial surface of the laterals rests against the palatine surface of the centrals. Then the rotation naturally ceases, the laterals forming an abutment. Pressure being exerted on both centrals, in this way an angle is formed, and the pressure on both sides being equal, they are not thrown out any farther. The direction of the cutting edges depends on the shape of the teeth.

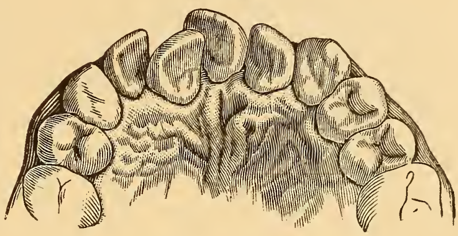
Fig. 46.



If the diameters of the cutting edges exceed much those of the necks, they necessarily overlap to a greater extent.

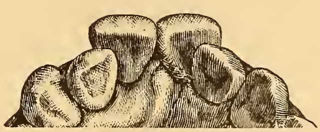
(*c*) When the two central incisors do not erupt harmoniously, one overlaps the other. (Fig. 47.) If, in addition to this condition, the force that is brought to bear on the anterior alveolar arch is very unequal, certain modifications occur. An unequal pressure exerted by the cuspids in their eruption will force one side of the arch farther forward than the other. When the first molar on one side has been extracted, while that on the other side remains, the forward movement is necessarily one-sided, and a corresponding irregularity follows. The tardy extraction of temporary teeth goes far in forcing the germs of the permanent teeth out of place. Irregularity in the lower incisors through faulty occlusion modifies greatly the direction of the upper teeth.

Fig. 47.



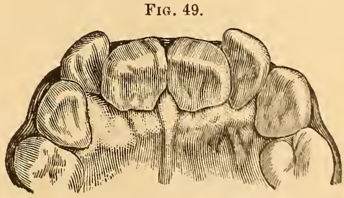
(*d*) Sometimes centrals projecting in a line in front of the laterals are met with. (Fig. 48.) In this case the centrals erupted properly; but the arch being undeveloped, there is not room for the laterals. These are carried forward by the posterior column and in by the cuspids, and are possibly driven in by the lower incisors, which, instead of striking within them, strike without exaggerating the difficulty. When this is not the case, and the laterals strike outside of the lower teeth, the upper arch is too large for the lower, and the upper centrals, not finding the proper support below, are forced out in a similar manner.

Fig. 48.



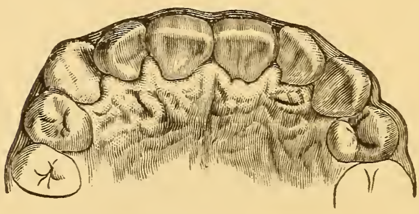
(*e*) A similar condition is that in which the central incisors strike within the laterals. (Fig. 49.) The cause is the same; but the laterals in erupting fail to find the proper support and project outward, while the centrals occlude properly. In this case the upper maxillary arch is not necessarily too large for the lower; but the teeth are crowded.

Fig. 49.



(*f*) One form of irregularity that is occasionally met with is that which gives rise to a right angle in the region of the cuspids, the incisors being in a straight line. (Fig. 50.) There are, of course, cases of this kind where the upper and lower arches resemble each other, and where the occlusion is fair, which, for these reasons, cannot be classed under irregularities. When this rectangular appearance is found in the upper jaw only, it is evidently due to a flexion in the region of the cuspids caused by the forward movement of the posterior column. The anterior alveolar column will be found thick, and is therefore capable of resisting the pressure of the posterior column, and the pressure is spent on the weakest point, *i. e.*, the region of the cuspid. Hence the flexion at this point. There is always an excessive development of the upper jaw and alveolar process. This causes the teeth to erupt too far forward for occlusion with the lower arch, and the lip draws them in until they strike the lower arch, and the long axes of the teeth point inward instead of outward. Thus the vault is brought forward, leaving the lower incisors without support.

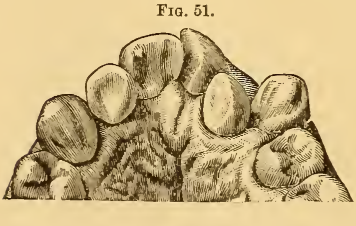
Fig. 50.



Irregularities Produced by the Malposition of Central Incisors due to Vicious Eruption.

(*a*) The laws that govern the eruption of the teeth and harmonize their development are occasionally interfered with. The germs that should be directly over the temporary incisors may be displaced. These should be situated above and anterior to the temporary teeth; but occasionally the germ is situated above and deflected posteriorly, and thus it is liable to be erupted on the palatine surface. A displacement of the germs generally results in vicious eruption; for however slight it may be, as the tooth progresses, the line of its axis must diverge more and more from that of its normal

Fig. 51.



position. The central incisors spring from a point farther back than it should be. If the elevation of the gum is followed, it will be seen that these two diverge more and more toward their cutting edges. Thus the relation of their axes is changed entirely, and a partial rotation is produced. (Fig. 51.)

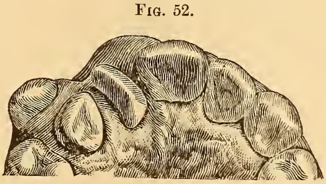
Again, if the roots of the temporary teeth persist instead of being absorbed as the permanent teeth advance, they materially interfere with the eruption of these, and are apt to turn them out of their course. When one of the conical roots of the incisors infringes upon another not in the same line, as the teeth develop, a tendency to rotation is established on the principle of the screw. This partial rotation upon its axis is more apparent the greater the diameter of the tooth; for the cutting edge, usually in line with the other teeth, now partakes of the revolution of the axis, and so forms an angle with the arch.

In these three cases, when the tooth is fully erupted it finds a proper resting-place on the opposing tooth, its malposition may be corrected by the exercise of its proper function; but it often fails to find this, and projects out, being without support.

(*b*) Adventitious germs appear occasionally in the alveolar process. When these are found in the arch, they necessarily disarrange the occlusion and throw the teeth out of their proper position. Supernumerary teeth usually appear at the median line, and then necessarily crowd all the teeth laterally. Frequently one supernumerary tooth is found exactly in the median line and centrals coming down to the right and left in the arch.

Occasionally two are found in the position where the centrals should be. In such cases the central incisors are generally located outside and anterior to the lateral incisors. When a supernumerary is found outside of the arch in the median line, one central may be in position, the other may be thrown out or in, and may be rotated 90° upon its axis. (See Fig. 52.)

Fig. 52.



Irregularities Produced by the Malposition of Laterals.

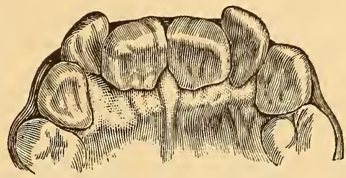
1. Mesial surface of lateral overlapping distal surface of central, while distal surface is in a line with cuspid.
2. Mesial surface of lateral overlapping distal surface of central, while distal surface is behind the cuspid.
3. Mesial surface of lateral behind the distal surface of the central, while the distal surface is in a line with the cuspid.
4. Lateral in a line anterior to that of central and cuspid.
5. Lateral in a line posterior to central and cuspid.
6. Lateral at right angles with the line of the incisor and cuspid.
7. Lateral wholly inside the arch.

The lateral is found more frequently out of position than any other tooth because it is the weakest tooth in the arch and has the shortest root, and is therefore more easily displaced.

We have seen that the position of the central incisor is the combined result of the relative strength of the alveolar process, the force brought to bear upon it by the posterior column and the cuspid, and the peculiarities of occlusion. The lateral, on the other hand, depends for its position on the combined force of central and cuspid. Like other teeth, each lateral depends upon the environments of its own side of the arch, independent of the other. Besides its weakness, two other conditions are productive of its change of position, (1) The shortness and conical shape of its root, (2) Its wedge-shaped crown. The shortness of its root, together with its conical outline, cause it to be more easily impinged upon by the root of the incisor, which will produce partial rotation. The wedge-shape of its crown facilitates rotation. The greater the diameter of the cutting-edge in proportion to that of the root, the greater the degree of rotation must be before the lateral finds a resting-place. If the diameter were equal to the space left, and there were no impinging on the root, there would be no displacements. But when the space is not sufficient for the lateral and a pressure is brought to bear on one side of either cutting-edge or root, there must be a partial rotation which is proportioned to the diameter of the cutting-edge. The wedge-shaped character of the crown assists in rotation, as the rounded angle of the anterior cusp offers less resistance than a line or surface. This gives rise to the com-

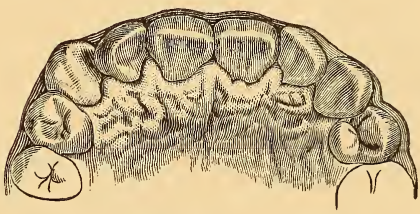
monest form of irregularity (1 and 2, Figs. 53 and 54), in which the mesial surface of the lateral overlaps the distal surface of the central, while the distal surface of the lateral is either in a line with the cuspid or just back of it.

Fig. 53.



3. In those cases where the lateral is in a line with the cuspid, (Fig. 55) but its mesial surface behind the central, the cuspid, having a much broader mesial surface, affords a firm abutment to the movement of the lateral, while the mesial surface of the latter easily glides over the narrow rounded distal surface of the central incisor. In this case the relative diameter of the upper and lower maxillæ determines the occlusion and position in a measure. If the lower maxilla and the upper are properly proportioned the lower incisor may strike in front of the upper.

Fig. 54.



4 and 5. Laterals not finding room in the anterior column are met with in a line in front of that formed by the central and cuspid, (Fig.

Fig. 55.

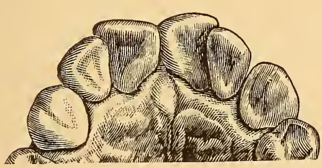
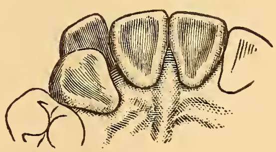


Fig. 56.



56) or behind it (Fig. 57). In both cases there is no rotation produced by a one-sided pressure either upon the root or cutting-edge. Whether the lateral is found without or within the line depends upon the relative diameter of the upper and lower maxillæ and occlusion. If the proper relation exists and the lower incisors strike within the upper, the upper laterals will be found outside the arch. When the diameter of the upper arch is greater than that of the lower, its laterals may be found within the line of the centrals and cuspids. In

this case the lower incisors must either strike over the upper, which occurs when there is a proper relation of diameters of upper and lower maxillæ, or else they may strike behind the upper laterals, which can occur only when the upper arch has a greater diameter than the lower.

Fig. 57.

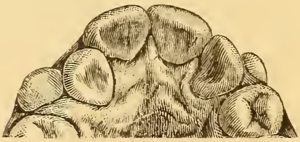
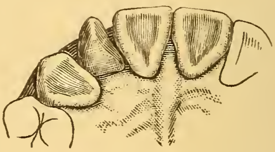
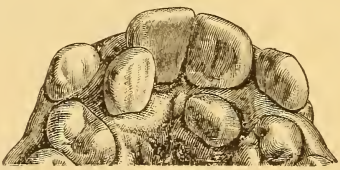


Fig. 58.



6. A rotation of 180°, so that the lateral is at right angles with a line passing through centrals and cuspids, can occur only when there is no obstruction to the movement of either root or cutting-edge and where there is no proper occlusion. (Fig. 58.)

Fig. 59.



7. Occasionally a lateral is found wholly inside of the arch. The cause is twofold. Sometimes the lateral is erupted so tardily that the cuspid pushes it out of its place. Then, again, even though it is erupted, in due time the greater relative (Fig. 59) size and strength of the cuspid may crowd it toward the palate.

CHAPTER IX.

LOCAL CAUSES—(Continued).

IRREGULARITIES PRODUCED BY THE MALPOSITION OF THE CUSPIDS.

The cuspid is the most important tooth in the anterior part of the mouth in regard to durability and influence on expression. It owes its durability to the hardness of its tissue, slowness of its development and simplicity of shape. The absence of sulci lays it less open to the inroads of caries. The pyramidal shape of its cusp gives it great power of resistance. Its strength depends on these conditions and the length of its root, which exceeds that of any other tooth. Owing to the length of its root its cusp may move farther from its normal axis without really forming a greater angle with it. It is placed at the angle between the anterior and posterior columns forming the key-stone; hence it is of the greatest importance in affecting expression. The shape of the crown may vary from the agreeable rounded outline of beauty to the prominence of the tusk of a wild best. The limits of variation of form and position thus being greater than those of any other tooth, it attracts more attention and does more to help make or mar beauty. The deviations from its normal position may be due to malposition of the germ or crowding out of place. It is difficult at times to determine which of these causes produces the irregularity, though generally it is clear.

When no source of pressure upon the erupting tooth can be recognized, such as is the case when the cuspid erupts in the vault, it is safe to assume the former.

In both the deciduous and permanent set, as compared with other teeth, the cuspids are late in erupting. In both it must seek its way between two teeth already erupted; hence its liability to be forced out of place.

The permanent cuspid rarely erupts before the twelfth year after the centrals, laterals and bicuspids are in position. It is crowded, and therefore meets with obstacles in its descent. Its crypt is placed above and in front of those of the lateral and bicuspid. As at the age of nine the roots of the incisors and bicuspids are pretty

well calcified, the cuspid may be materially hindered in its eruption by these when there is a lack of space. Its conical root makes it yield easily to pressure, and its cusp glides readily over the roots of the adjoining teeth. If the relation between the calcification and decalcification of the temporary teeth does not take place simultaneously a new factor of disturbance arises, for by the pressure of an additional obstacle, in the shape of a remaining portion of the root of a deciduous tooth, the cuspid may be thrown out of its course, while a too rapid absorption of a deciduous root leaves the column of resistance broken, thus opening a new channel for the erupting tooth.

The position of its crypt above and in front of those of the lateral and bicuspid accounts for the most common form of irregularity, *i. e.*, being outside of the arch and above the other teeth. The tendency of the cusp is necessarily forward, because the combined force of the bicuspids and the first permanent molar from behind is greater than that of the lateral in front; hence the lateral is easily pushed out of place. Besides, the roots of all teeth naturally pointing backward would give it this tendency.

When in its normal position the cuspid pushes its way between the roots of the lateral and bicuspid, and thereby spreads the arch, giving it a parabolic outline and forming a key-stone; but when it remains outside of the arch, the expanded contour is lost and a

Fig. 60.

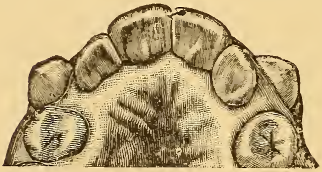
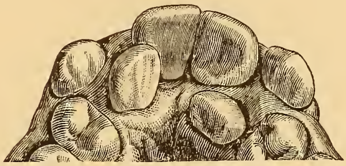


Fig. 61.

pinched condition results in the shape of a V-shaped arch. The additional pressure of the cuspid upon the region of the lateral only increases this tendency. The cuspid when out of place is usually found above and outside of the lateral and bicuspid, this tendency being given by the position of its germ and its calcification being late as compared with other teeth. (Fig. 60.)

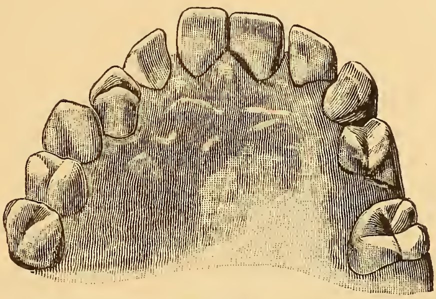
One or two cuspids may be found erupted in the palatal vault when there is a malposition of the germs. (Fig. 61.) Occasionally

FIG. 62.



it is found outside of the first bicuspid or between the first and second bicuspid, sometimes in front or anterior to the lateral. (Figs. 62

FIG. 63.



After Wilson.

and 63.) Frequently it takes the place of the lateral. (Fig. 64.) Sometimes one cuspid is found in the palate while the other is on a

FIG. 64.

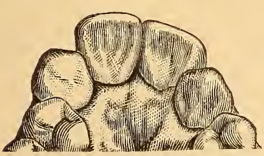
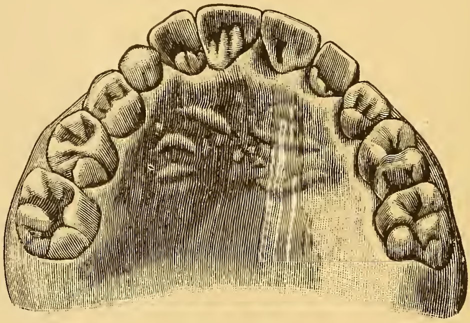


FIG. 65.

line pointing inward. (Fig. 65.) When it comes through in this position the deciduous cuspid may still be in position, the first bicuspid

having crowded forward to the lateral. (Fig. 66.) Occasionally when the cuspid is missing, the lateral will drop backward. (Fig.

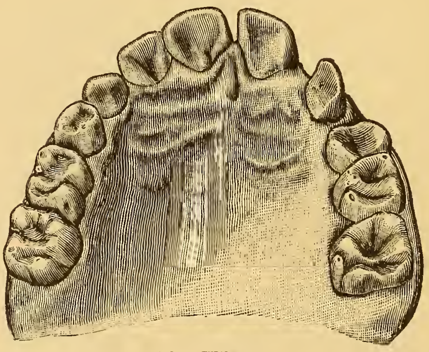
Fig. 66.



After Wilson.

67.) Its usual position when in the palate is inside the lateral incisor, but sometimes it is embedded in the hard palate. A pinched con-

Fig. 67.



After Wilson.

dition in the bicuspid region necessarily results from such malposition, owing in part to the want of prominence of this tooth when

Fig. 68.

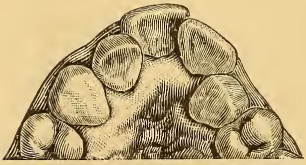
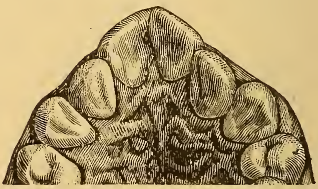


Fig. 69.



in its normal position and in part to the inward pressure of the cus-

pid upon the bone-cells. (Fig. 68 and 69.) When the cuspid moves out of position it does so at the expense of the first bicuspid and lateral incisor. The force may be so great as to push the lateral forward and through the alveolar process. When the cuspid is found in the roof of the mouth, or out of its normal position, the posterior column moves forward, filling the space usually occupied by the cuspid, (Fig. 64), and the half of the arch of which this tooth is a member remains undeveloped. (Fig. 68.) If the cuspids erupt simultaneously the pressure exerted is uniform, and there is less liability to irregularity. One may erupt normally while the other may be abnormal in position.

Irregularities Produced by the Malposition of Bicuspids.

The shape of the crown of the bicuspid particularly endangers it to irregularities of position. The antero-posterior diameter of its outer cusp is greater in proportion than that of the inner, having a wedge-shaped space on the palatal side. This causes it to touch at one point the tooth in front and back of it, and makes rotation upon its axis easy. Irregularities are chiefly limited to the second bicuspid for reasons that become apparent when we consider their causes.

Like irregularities of other teeth, irregularities of bicuspids may arise from constitutional causes, *i. e.*, from a lack of accord between the size of the jaw and that of the teeth, or from local causes. The latter are frequent and come under the following heads: 1. Tardy eruption; 2. Deflection due to the retention of temporary roots; 3. Forward movement of the molars; 4. Rotation from want of occlusion.

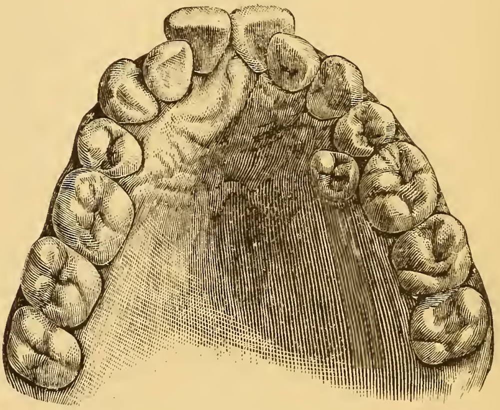
1. *Tardy eruption.*—The natural order of eruption is: first bicuspid; second bicuspid; cuspid. But this is disturbed occasionally so that the first bicuspid is followed by the cuspid, thus pushing it backward. When there is a lack of space the second bicuspid must seek its way between the first bicuspid and the first permanent molar, and if there is a lack of room it is crowded outside or within the arch. (Fig. 70.)

2. *Deflection.*—When a temporary molar is retained too long, or its root is not absorbed as fast as the bicuspid is erupted, this obstacle may deflect the bicuspid or cause it to rotate more or less upon

its axis, being favored by the spongy character of the alveolar process. (Fig. 71.)

3. The forward movement of the molars necessarily diminishes the space left for bicuspids and cuspids, and when the first bicuspid and

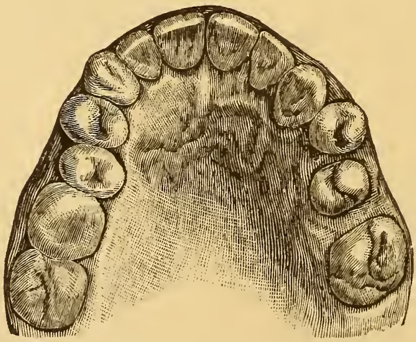
Fig. 70.



cuspid erupt before the second bicuspid, this may be crowded out of its proper place.

4. A rotation of a bicuspid from a want of proper occlusion is not rare. An examination of the grinding surface of the bicuspid shows that it is designed to articulate with an opposing tooth. When its

Fig. 71.



two cusps fail to find an opposing cusp to keep them in place its function is lost and its fixedness of position endangered.

Frequently more than one of these causes are at work, or one implies another. Thus if there is accord between the size of the jaw and that of the teeth, some of the local causes cannot arise, the cuspid may erupt before the second bicuspid without disarranging the arch, and a bicuspid may be deflected by a deciduous root and ultimately move into place unless crowded upon by a six-year molar. Rotation may be the result of a crowded condition, throwing the tooth out of the arch when proper occlusion is out of the question.

As the first bicuspid erupts before the second, it has all the advantage of such space as there is. It may be crowded out of place by the forward movement of the six-year molar together with the premature eruption of the cuspid. Permanent deflection due to the retention of a deciduous root is out of the question when there is sufficient space, but rotation upon its axis from want of proper occlusion may occur here as elsewhere.

The posterior surface of the bicuspid touches the first cuspid only at one point, being an angle and not a surface, and this is a fruitful source of irregularity.

Irregularities of the Teeth Produced by the Extraction of the First Permanent Molar.

Irregularities first attracted attention by the deformity they produced, not by their interference with function. Overcrowded anterior portions of the arch and displacement of individual teeth were noticed. A long time elapsed before the results of injudicious extraction were observed. Therefore, the first permanent molar was ruthlessly destroyed until comparatively recent times, producing a large proportion of irregularities in the form of malocclusion. This loss of function is produced so gradually that the patient is not aware of it; he may notice inconvenience in mastication, but does not attribute it to the cause, as even persons of great intelligence know little about the occlusion of their teeth.

This tooth has been hitherto sacrified for two reasons:—

1st. Its early decay, brought about by the tax upon the system of the growing child and the neglect from which the teeth suffer, particularly during the period of its development. The parent usually does not know of its existence until the child complains of toothache.

2d. The tooth has been extracted to correct an overcrowded arch.

When removed to stop pain, the pain is indeed relieved by extraction, but has in its train many evils hereafter pointed out. When removed to correct a crowded arch, twice as much space is gained as desirable, and the crowded arch is not relieved, as the cuspid, because of the length and strength of its root, remains stationary, while the bicuspids move back singly or in pairs, leaving the position of the incisors unchanged. The disastrous effects of extracting the first molar become apparent when its function is understood. We cannot do better than give its fourfold function as stated by Dr. J. E. Cravens, of Indianapolis, in the annual of *Universal Medical Science* of 1888:

"The permanent first molar has four distinct functions: (1) To supply additional surface for mastication when development has progressed so that the deciduous molars, unaided, are no longer competent to meet the requirements of nature. (2) To support the crowns of the deciduous molars when they have become unstable, because of absorption of their roots to accommodate the advance of their immediate successors, the bicuspids, which are usually erupted between the ninth and the eleventh years. The deciduous molars begin to loosen six to twelve months before their final displacement. Should a permanent first molar be extracted early—say between the seventh and the eighth years—the deciduous molars supported by it would loosen prematurely so as to be unserviceable for mastication, and perhaps be lost six to twelve months before the eruption of the succeeding bicuspids. (3) To guide the second bicuspid into position in event of a loss of this molar previous to eruption of the second bicuspid, the latter is liable to erupt back of its true position or after erupting nominally to float backward along the ridge of the gum, inclining posteriorly, in such a manner as seriously to impair its effectiveness as a masticating organ. This is particularly the case in the inferior maxilla. (4) To induce additional development of the horizontal portion of the lower jaw, immediately anterior to the ramus, in order to make easier the eruption of the permanent second molar, and to prevent the well-known tendency of the latter to tip forward, thus weakening the support of its roots and impairing its value as a grinder.

"The permanent first molar is supposed by many observers to exercise an important influence in establishing a proper angle to the inferior maxilla. If such idea is correct (and several conditions

indicate that it is), it adds possibly another to the already long and important list of the functions pertaining to this tooth."

The wholesale extraction of the first permanent molar in the past has, no doubt, caused arrest of development of the alveolar process as well as of the maxillary bones, for the process and jaws depend for their development largely on the function of the teeth, their articulation and their motion stimulating nutrition and enlarging the arch.

Some of the older dentists, whose skill is the result of routine rather than knowledge, are still to be found extracting four sound molars without the least thought of the consequences. Such a one who was practicing in a southern parish not many years ago was in the habit of taking out the first permanent molar in *every instance.* He said the result was "that all the people in that part of the country possessed good regular teeth, and that an irregularity was the exception." The author has observed in many cases the want of development of the alveolar process and sometimes the jaws from the extraction of those teeth. This assertion is verified in those cases where the germ has not developed and the tooth is missing. More marked instances are those where three or four germs are wanting. The loss of a tooth performing such a work as the first permanent molar impairs mastication, and produces vicious occlusion and is detrimental to the contour of the face. When extracted before the second molar is erupted, one-half or more of the grinding surface of the teeth is lost.

The nutrition of the patient suffers in proportion, and health may be seriously impaired because of inability to masticate food properly.

The horizontal portion of the lower jaw will be but imperfectly developed, because function, one of the most important means of development, is lost and insufficient room is left for the second and third molars.

When a jaw with deciduous teeth is compared with one having permanent teeth, we notice a difference in the length of the rami and bodies, and a still greater difference in the angles. This difference results from the gradual separation near the angle and is due to the growth of the molars. The arches of the permanent set are separated posteriorly by the eruption of the first permanent molar. When these molars are lost before the second molars are in place, the characteristic angle of the jaw becomes less marked. The loss

of this molar on one side only will produce asymmetry of the two sides of the face, noticeable perhaps only to the trained eye, the parallelism of the two arches having been disturbed. If the two are lost early, the jaws approach each other more than normal near the angle, throwing the force of mastication forward. As the first and second bicuspids do not erupt until the tenth or eleventh year, and the deciduous molars loosen six to twelve months before they are displaced, the child is forced to masticate its food for several years on a portion of the arch designed for other purposes, compelling these teeth to perform the unnatural function of grinding. This confusion of functions produces but imperfect results and changes the outline of the face.

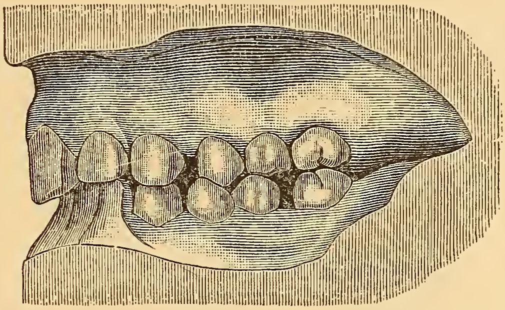
As the first permanent molar erupts it acts as a fixed point, separating and holding the jaws somewhat throughout their entire extent in front as well, so as to make room for the growing incisors. The deciduous incisors, being very much shorter than the permanent ones, necessarily have a shorter bite. When the first permanent molar is lost the natural bite is shortened, for this molar acts as a force which lengthens the arches backward and also separates them vertically.

When this tooth is lost the lower permanent incisors as they develop strike with greater force against the upper and are carried forward. The change at first is imperceptible, but in the course of time these teeth will be found spreading more or less like a fan. Though the organic relation of the upper and lower jaw is not so apparent at first as that of other organs, and the two jaws seem to enjoy greater independence, proper occlusion is indispensable to their health, and the teeth in the lower arch are forced out of their sockets by a deposit of osseous material not consumed through proper function.

Naturally bicuspids tend to move forward because of the inclination of the root and the angle formed by the two jaws, which makes the teeth strike at an angle as well. This tendency usually prevents them from moving back, even if the first molar is extracted. When the cusps are long they usually retain their natural articulation, but sometimes, as has been pointed out, they move backward. They may move back separately or may drop back together. (Fig. 72.) This dropping back destroys the articulation, causing the opposing teeth to strike only at certain points instead of bringing surfaces in contact, and frequently partial rotation upon their axes results.

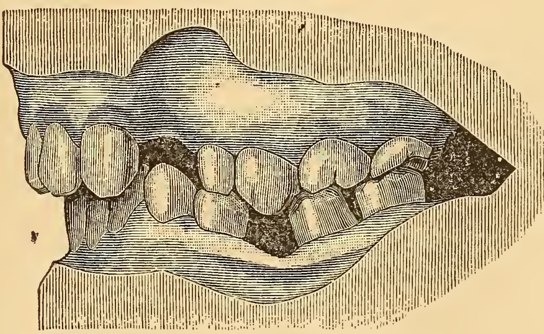
The most ordinary result of the extraction of this tooth is the forward movement of the second and third molars (Fig. 73), caus-

FIG. 72.



ing these to tip forward and resulting in vicious articulation, as shown by Dr. Davenport in the *Dental Cosmos* of July, 1887. Externally the articulation may appear not to have suffered, but when

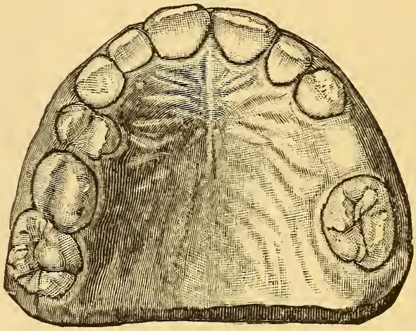
FIG. 73.



it is examined inside of the arch, it is found that the opposing teeth meet only at certain points, becoming thereby partially useless. Fig. 74 shows the forward movement of the first permanent molar. The temporary molars on right side are in place, thus holding the first permanent molar in place, while on the left side the temporary molars have been extracted and the first molar has moved forward one-fourth inch. The force of mastication and the direction of the roots together with the eruption of the second molar increases this tendency.

Length of the rami, body, depth of sulci of the masticating surface and local peculiarities of the teeth in front may so modify the

Fig 74.



occlusion as to result in bilateral asymmetry, and the degree of tipping forward may be quite unlike.

Local Irregularities of the Lower Jaw.

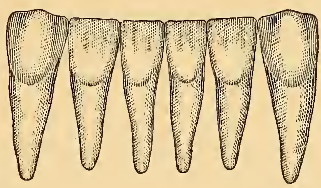
The upper and the lower jaw are quite distinct in character, function and course of development, however similar they may appear to be.

The upper when normal describes a portion of a larger circle, the teeth overlapping those of the lower. It is fixed, and depends for its function entirely on the activity of the lower. Owing to this immobility, when irregularities exist they are of a more marked constitutional type. Thus we have the various abnormal arches not seen in the lower; the high and narrow vault and the inward curvature of alveolar processes. It has a greater sweep of development, and consequently greater possibility of irregularity in its anterior columns, because these are unrestricted, while the lower is restrained by the overlapping of the upper teeth. The lower jaw is hung loosely, but firmly, by its condyles, permitting motion in three directions,—antero-posterior, vertical and lateral.

In Fig. 75 the six anterior inferior incisors are shown. Observe that the points of contact are at their cutting edges, the mesial and distal surfaces being rounded, which enables them to crowd easily past each other when force is applied; the roots are flattened at their sides, so that when pressure is brought to bear upon them they move

with readiness over a considerable distance. That the pressure cannot well be exerted in a straight line through the posterior column, and from thence extend in a curve through the anterior teeth, appears from the law of simple forces, which act in straight lines only. The cuspid, finding no resistance in front, but being resisted by the incisors slightly at the side, must necessarily pass forward. The lateral is too weak to afford resistance. Even if the centrals could be acted upon by the pressure from behind, they could be prevented from assuming a V-shape by the overlapping incisors

Fig. 75.



above; for the more the upper arch is compressed laterally, and the mesial angle of the central is turned outward, the more will the distal angle be turned inward, and thus confine the lower incisors.

The lower incisors being narrower than the upper only favors this tendency. These conditions are necessarily modified by the local peculiarities of the upper arch, the relative strength of the teeth and the nature of the occlusion being all-important factors in determining final results.

Fig. 76 is a diagram of a normal lower maxilla. The line *a b* passes through the cuspids, bicuspids and molars, and shows the direction of the force exerted by the posterior column upon the anterior. For its growth it depends far more upon function than the upper. The growth of the lower jaw is limited to the posterior column, as has been mentioned, this being accomplished by the absorption of the anterior border of the rami, while bone-cells are deposited along its posterior border. Its freedom of motion is, however, retarded by the arch of the upper maxilla, for which reason irregularities are much rarer in the lower than the upper jaw as the

overlapping of the upper teeth tends to correct any predisposition to mal-arrangement.

Irregularities of this jaw result more from local causes than those of the upper maxilla, except those found in the underhung jaw. Its development depends largely on mastication. Owing to its movements there are fewer irregularities in this maxilla and the jaw is more apt to be normal. Irregularities back of the cuspid are very rare. Occasional contractions of the lower arch occur, such as dipping in, which is due to peculiarities of occlusion. When cases of irregularity exist they are generally found in mouths the lower arch of which exceeds the upper in diameter, thus permitting less firm interlocking and greater freedom of individual teeth.

Fig. 76.

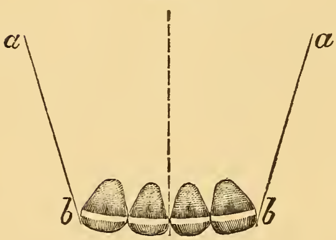
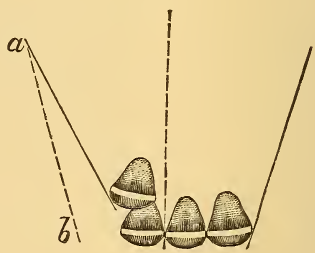


Fig. 77.



When the diameter of the circle of the teeth of the lower jaw exceeds that of the upper, its lateral movement causes an enlargement of the upper circle by opening the median suture, this condition being indicated by the spreading of the superior central incisors. As has been shown in the chapter on migration of teeth, twisted bicuspids often result from entire want of occlusion or the touching of two opposing teeth at only one point. The most frequent form of irregularity is a crowding of the incisors. This is generally the case where the size of the teeth and the jaw are not in harmony, and is due to two causes: 1st. The teeth of the lower jaw are forced inward by occlusion, the diameter of the circle of the upper teeth being usually the smaller; 2d. The forward movement of the posterior column.

The two halves of the lower arch, like those of the upper, for obvious reasons do not present the same forms of irregularity. Like the upper jaw, the lower is subject to forward movement of the

posterior column. A want of harmony in the development of upper and lower maxillæ produces a crowded condition of the lower arch, resulting in pressure upon the anterior column.

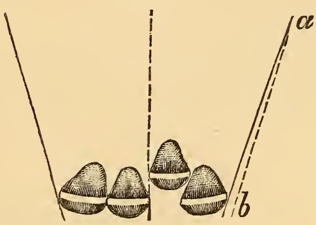
The direction of the roots of the lower molars greatly increases this tendency. When the crowns of the second and third molars are erupted the first molar is pushed forward. The pressure is exerted principally through the posterior column upon the cuspid and is in a straight line. This tooth, by virtue of its rounded cusp, slips by the lateral and is projected forward often beyond the central incisors, leaving the lateral behind.

Like the upper maxillæ the two halves of the alveolar arch are separate, and are modified independently. An irregularity on one side by no means indicates a similar irregularity on the other, owing to the difference of pressure that may be exerted.

Fig. 77 shows the left dental arch normal, but the forward movement of the posterior column has caused the right lateral to fall

Fig. 78.

Fig. 79.



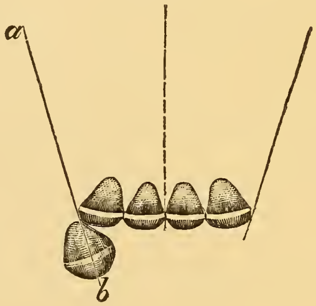
behind. As the two columns converge anteriorly they exert their pressure in this direction, in consequence of which we find irregularities of the lower jaw confined for the most part to the region of the incisors.

Though, as stated before, the laterals are generally pressed within, while the centrals occupy their usual position, these teeth may stand at various angles which are determined by the local peculiarities of the teeth of the upper maxilla. Thus it may happen that a cuspid or a lateral may strike outside of its antagonist of the opposite jaw.

Fig. 78 illustrates a common form of irregularity in which both posterior columns have moved forward. The laterals are crowded backwards and inwards. The lines of force are also directed in-

ward, but a V-shaped arch is prevented by the lower centrals striking against the palatal surfaces of the upper centrals. If the cause of this form of irregularity is borne in mind it will be understood why the extraction of a lower lateral or central makes this

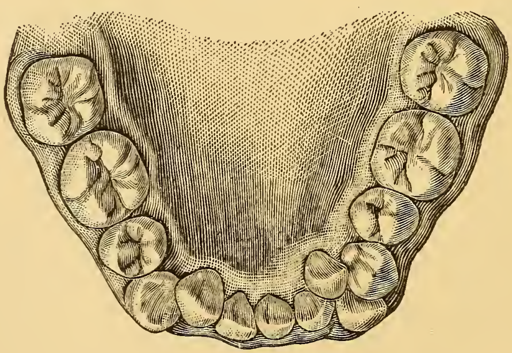
Fig. 80.



form of irregularity still worse, inasmuch as it disarranges the occlusion of the cuspids.

In Fig. 79 we see the right dental arch normal. The left posterior column has pushed against the lateral, and meeting with

Fig. 81.



sufficient resistance, the central is carried backward. While erupting, the central was carried inward, owing to a want of harmony of development. Two centrals have been found directed inward, though this form of irregularity is rare.

Fig. 80 shows the left dental arch normal. The forward movement of the posterior column on the right side has caused the cuspid to advance beyond the line of the incisors. The rotation of the cuspid upon its axis caused it to pass by the lateral, leaving it in position. This is a common form of irregularity. Occasionally the cuspid is carried forward in the direction of the pressure. Such a case is illustrated in Fig. 81. The left lateral has been carried inward in the manner already described. The posterior column has pushed the cuspid on the right side laterally so that it occupies the position of the right lateral and the bicuspid is carried forward and outside of the arch.

The Inferior Cuspid.

The cuspid erupts in line with the other anterior teeth unlike the upper, the crypt of which is above and outside of the lateral incisor and bicuspids. For this reason and the fact that the upper cuspid tends to keep it in position by occlusion, irregularities of the cuspid of the lower jaw are not so common as those of the upper. When the tooth is found out of line, it is anterior of its normal position, —rarely, if ever, posterior. Its eruption may be tardy, giving the advantage of time to the upper cuspid and directing the lower cuspid outward. In a crowded jaw a disarrangement of the incisors may follow, leaving the lateral almost directly behind the cuspid, as in Fig. 81. When there is a malposition of the cuspid on one side of the maxilla, the cuspid of the opposite is usually pushed forward, as seen in the same illustration.

Fig. 82.

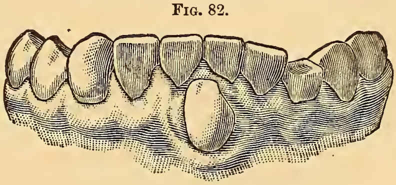
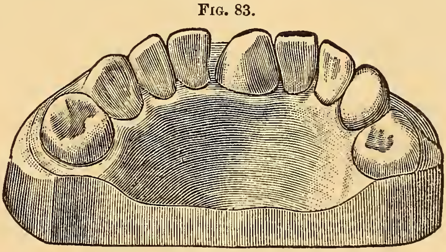


Fig. 83.



Owing to a malposition of the germ, the cuspid may be found outside of the incisors in the median line (Fig. 82), or even inside of the arch (Fig. 83). Rarely it is found on the median line between the incisors as shown in this illustration.

Lower Bicuspids.

Like the cuspid, the position of the bicuspid is most frequently affected by the forward movement of the posterior columns. An irregularity in a lateral direction is rare, since the density of the lower maxilla is unfavorable to this.

Whenever a bicuspid is found without or within the arch, it is due to the undue retention of the temporary teeth. Fig. 84 shows the second bicuspid situated inside the arch, while Fig. 85 shows the first bicuspid inside and the second bicuspid outside of the arch. Twisted bicuspids occur frequently from a want of proper occlusion, when the space yielded by the lower jaw is larger than that of the upper, or when the first molar is extracted.

Fig. 84.

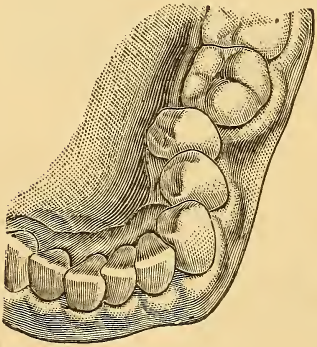
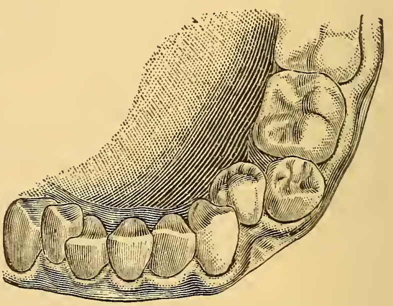


Fig. 85.



When the second temporary molar is retained too long, the first permanent molar may be pushed forward, thus confining the bicuspid and preventing it from erupting.

CHAPTER X.

ANTERIOR PROTRUSIONS.

MIGRATION OF TEETH.

That teeth move when acted upon by some external force is known to every practitioner, and is utilized in his operations by producing temporary separations, in regulating and the like. Why they should move from their normal position without any apparent cause is not so easy to explain, and theories have been recently advanced to account for this. It is obvious that when the arch of the alveolar process is greater than that of the combined diameters of the teeth, there must be a space or spaces somewhere. This space is usually equally distributed among the anterior teeth. Sometimes, however, spaces are found that disfigure the mouth, and besides these we find occasionally one or more teeth that appear to have rotated upon their axes. An inquiry into these forms of motion is the province of this chapter.

This subject is best considered under two heads.

A. Perfect occlusion.

B. Proper relation between waste and repair.

A. If the occlusion of the teeth is perfect, so that each tooth is kept in place by its adjoining neighbors and the opposing tooth, dislodgment is impossible. All teeth should touch those adjoining them at the extremities of their greatest diameter. This allows a slight lateral motion.

Good occlusion differs according to the function of different teeth. Their shapes indicate this. The upper and lower incisors overlap each other, producing what is termed the *overbite.* In the normal relation they strike in a straight line which passes through their roots. The curved lingual surface of the upper incisors allows for their sliding into this position. The force being thus exerted in straight lines, there is a constant tendency to keep them in position,

and as the pressure upward and downward is vertical, spreading of the upper incisors is impossible. The relation of cuspids is similar. Quite otherwise with bicuspids and molars. Beginning with the bicuspids, we find the cusps of the first superior bicuspid striking not over that of the first lower bicuspid alone, but over the angles formed by the distal side of the first lower and mesial side of the second. Each tooth beginning at this point is not only in relation to one below, but to two, and when one of these teeth is extracted the order of the mouth is disturbed and a rearrangement of some kind usually follows. What this will be depends on a variety of circumstances.

A typical example is furnished by the extraction of the first molar. Every practitioner has observed the forward movement of the second molar as a consequence. A tilting forward of this tooth results. The reason for this is obvious when we remember that the posterior cusp of the first upper molar strikes the anterior cusp of the second lower and exerts its whole force, which was meant to be distributed on both cusps, on it.

B. The position of the teeth is not determined alone by the relative size of the maxillæ and the occlusion of the teeth. Nutrition and absorption, waste and repair, play an important part. On the perfect harmony of these the beauty and health of the teeth depend. Changes in the position and removal of bone-cells go on constantly and vary with the age and other physical conditions of the patient. This disposition and removal of bone-cells is seen in the changes that the lower maxillæ undergo during different periods of life. When the deciduous teeth are replaced by the permanent ones, the arch of the jaw becomes more pronounced, and there is a lengthening of the alveolar ridge backward to accommodate the molars. When the senile changes take place the angle of the jaw becomes more obtuse. That there is a similar adjustment to circumstances going on constantly is proven by circumstances. Correction of irregularities depends on this. The position of the teeth in the alveoli is determined solely by the tissues around it. By producing a pressure in a given direction, bone-cells may be removed on one side and others deposited on the other and the position of the tooth changed. The change in the deposit and removal of osseous matter is not unlike that of the deposit of particles of earth in the bed of a river where stakes have been placed for the purpose of locating the bed of

the river. By the successive deposit and removal of these particles the position of these may be changed and even the current of the river. This illustration may help to make clear changes in the contour and density of the alveolar processes depending on the changes of blood-supply and absorption. Irritation may thus stimulate the activity of the capillaries to a more than ordinary degree of repair.

Every tooth exerts a pressure of its own in different directions. Were this not so it would be difficult to account for the elongation of a tooth when its opponent is extracted. This pressure is healthy and implies the antagonism of opposing teeth. If this occlusion is wanting, the relation of waste and repair is disturbed. An excess of bone-cells is often deposited as a result.

When these two fundamental laws of good occlusion and balanced waste and repair are violated one of the three following conditions may follow:

(1), The movement of individual teeth in straight lines.

(2), The rotation of individual teeth upon their axes.

(3), The forward movement of groups of teeth and the alveolar processes supporting them.

The Movement of Individual Teeth in Straight Lines.

It was stated above that when the alveolar processes and teeth correspond in size and the occlusion is good that spaces between the teeth are out of the question. Sometimes a space is found between the central incisors. If the occlusion is good otherwise, this space is due to a continuance of growth at the margin of the suture, *i. e.*, there is a greater deposit of osseous material than is needed, producing a larger diameter the jaw than the teeth. This begins usually at an early period in life and continues till the growth of the osseous system has ceased. As the jaw develops in the child while the temporary teeth remain, it is but natural that spaces should be formed in time until the permanent teeth take their place.

Spaces may be artifically created in time by forcible separation by means of wedges. In former years, when more force was applied by dentists, irritation was created, and absorption on one side induced. In this way several teeth were sometimes crowded in one direction. When the anterior incisors do not strike on a line, but at an angle,

so that the cutting-edges of the lower incisors strike against the inclined plane of the lingual surface of the upper incisors, an outward pressure is exerted and the incisors separate. The spaces that are so frequently seen in the permanent incisors in children are in many cases produced by the tardy eruption of the cuspids. When the cuspids come down into place these spaces disappear. Spaces are rarely if ever observed between molars.

Again, the lower jaw, if too large for the upper jaw, may act as a wedge, and by striking against it may spread the central suture. The spaces between these teeth are usually found to be healthy. It is not reasonable to suppose that either salivary or germinal calculus or inflamed gums could produce this motion. Were the pressure exerted on one side only there might appear to be some ground for this supposition, providing calculus exerted a pressure too great for the rest of the teeth to resist. But when calculus is deposited on both sides the pressure exerted would be counterbalanced and lateral motion could not take place. Those who hold this opinion are probably misled by the fact that a tooth may be dislodged by calculus from its socket vertically. But this is in accordance with mechanical principles. In this case the calculus diminishes the diameter of the socket and the wedge-shaped root is forced out.

Rotation of Individual Teeth upon their Axes.

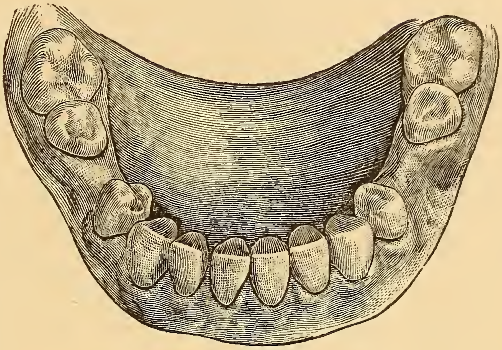
When a tooth touches its opposites only at one point or the opposing tooth was extracted, as it frequently happens with bicuspids, instead of articulating with surfaces, rotation may result. In this case bone-cells are deposited on one side, while those at an angle with these are removed. This produces a slight rotation which twists the tooth. That this process is physiological, is proven by the healthy state of the gums and alveolus which is found in most of these cases. Fig. 86 not only shows the rotary motion to the bicuspids, but also spontaneous motion in direct lines—a condition frequently observed by the author.

The Forward Movement of Groups of Teeth and the Alveolar Process Supporting Them.

In young persons, when the blood supply is rich with nutritious material, and when waste and repair go on rapidly, the four

and sometimes six anterior teeth and alveolar processes are carried forward. This proper occlusion with the inferior incisors becomes impossible, and these become elongated and, failing to find a support in the upper incisors, strike against the roof of the mouth. Irritation is produced and an excessive flow of blood to the parts follows. Thus we have:—

Fig. 86.



Anterior Protrusions from Constitutional and Local Causes.

One of the most interesting forms of irregularity is that in which the inferior incisors impinge upon the mucous membrane of the roof of the mouth and the superior centrals, laterals, cuspids and bicuspids, having moved forward, project to such an extent that the upper lip cannot close over them. It should be observed:

1. That these cases are not confined to normal individuals, but are found among idiots, deaf and dumb, blind, demented and insane.

2. The deformity is not seen in temporary teeth, but is confined to the permanent set, beginning at the seventh or eighth year and increasing with age. When not corrected the teeth will finally project at an obtuse angle, as is illustrated by a case of a woman fifty-five or sixty years of age that came to our notice, whose teeth projected almost horizontally.

3. The vault connected with this irregularity is usually low, though sometimes high, in which case it is more pronounced; just as V and saddle-shaped arches are more pronounced when associated with a high vault.

4. The irregularity begins at the central incisors, extending backward.

5. Generally later in life tartar collects around the roots, and Riggs' disease sets in, exaggerating the condition.

6. In the majority of cases the superior maxilla is arrested, and

the teeth project at an angle of 20°, carrying the alveolar process with them, in order that they may strike over the lower incisors.

Dr. Kingsley who first described this form of irregularity, is right in his statement that this condition is neither inherited nor the result of thumb-sucking. The conditions under which this irregularity is brought about are both constitutional and local. It should be noticed that the excessive proliferation of bone-cells does not begin before the sixth or seventh year, hence not until the permanent teeth are erupted. A want of balance of nervous function, resulting from neurotic conditions or a transmitted tendency to disease, may interfere with the centres of ossification, which interference, as has been shown, frequently finds expression in the anterior part of the mouth sometimes producing a high vault, contracted arches, or excessive or deficient deposition of bone-cells. An excessive proliferation of bone-cells near the median line of the superior alveolar process tilts the axes of the erupting centrals slightly outward. This direction once being given to them, when the lower incisors strike against them they do not find the resistance of correct occlusion, but act upon them as upon an inclined plane, throwing them out more and more during the process of eruption. This must necessarily terminate in striking the process itself, increased activity of nutrition which irritation sets up, resulting in excessive development. The tilting forward of the upper incisors increases the distance between them, and the lower incisors do not find the resistance belonging to natural function. The consequence is the elongation of the lower anterior alveolar arch, a circumstance to be noted in these cases. The eruption of the first permanent molars determines the relation of the jaws to each other; occasionally they do not develop their full length. In either case the lower incisors strike against the mucous membrane of the

Fig. 87.

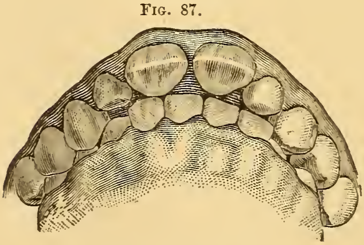
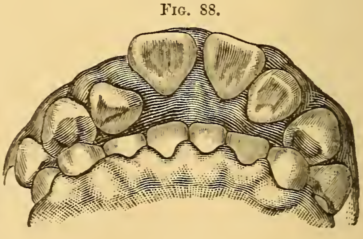


Fig. 88.



roof cf the mouth, which constant irritation stimulates the deposition

of bone-cells in the process, as if nature would defend it against the abnormal pressure of the lower teeth. Were the occlusion correct, the constant pressure on the roots of the teeth would doubtless, in part, counterbalance the excessive deposit by waste. As it is, the roots of the upper incisors form an angle with the cutting-edge of the lower teeth, and as the mouth opens and closes, the force of the lower incisors is not only spent on the superior process, but also through it on the roots of the upper teeth, forcing them out more and more. Fig. 87 shows the starting-point. The central incisors have just commenced to move forward. The model is from the mouth of a girl eleven years of age. The trouble is extended to the neighboring teeth from the nature of the occlusion. Fig. 88 shows the incisors and alveolar process carried forward by the excessive deposition of bone-cells. By the action of the lower lip, which cannot close over the cutting-edges of the upper teeth, but soon gets between the superior and inferior incisors, the former are pressed out still more. Fig. 89 shows a side view of this form of irregularities. Fig. 89-A illustrates a remarkable case of migration of the molars.

Fig. 89.

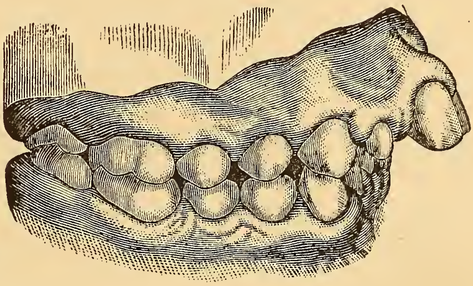
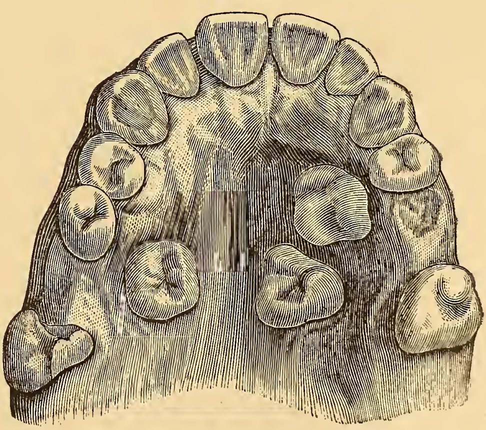


Fig. 89-A.



Want of function encourages a deposit of tartar around the roots of the teeth, inducing Riggs' disease later in life and loosening the teeth.

CHAPTER XI.

SUPERNUMERARY TEETH.

Supernumerary teeth are a freak of nature, for which no cause has, as yet, been assigned. It may, of course, be stated that additional germs were formed during fœtal life, but this is no true explanation, for the question still arises, "What caused these?"

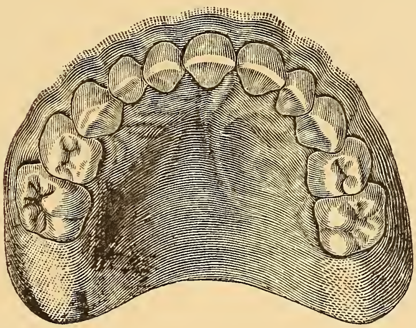
Plants put forth adventitious buds and show monstrosities in all their organs; animals are not always developed according to the law of their species; the human race shows monstrosities in every organ. It is therefore not to be wondered at that we see additional teeth. They were noticed by the earliest writers on dentistry, even before Christ. There is no doubt that what the public calls a double row of teeth is often merely malposition of the regular member, and that many a supernumerary tooth, when well formed, escapes notice. It is best, before making a statement in doubtful cases as to the class to which the supernumerary tooth belongs to take an impression; then it can be studied and compared with the rest at leisure.

Deviation from the normal number is more marked in the permanent than the temporary set. Little mention has been made of deviations in number in the deciduous set, because more rare and because the deciduous teeth have less individuality than the permanent ones, which would cause an additional tooth to escape notice. The author has come across four cases in his practice of supernumerary laterals in deciduous teeth. Three of these cases presented a supplemental lateral on the right side (Fig. 90); the fourth had them on both sides. It is interesting to notice that the excess was found mostly on the right side, for the reason that greater development of organs on the right side, including the jaw, have hitherto been ascribed to more frequent use. As the germs of the temporary teeth are formed before birth, this theory cannot stand in this instance at least.

When we come to the permanent teeth we find a distinction between cases presenting merely a variation in number and those

showing malformed supernumerary teeth. These may be considered under the heads of supplemental teeth and monstrosities. The former are like normal teeth, and it is difficult to distinguish them from these. The contour of the latter, like that of all monstrosities, is governed apparently by no law, excepting a want of definiteness.

Fig. 90.



However, the root is conical and the crown may be lobed or have the appearance of having been partially folded or poorly formed.

Adventitious teeth are more frequently found in the upper jaw than in the lower. It is a rare thing to find a well-formed supernumerary central incisor. The author has a cast showing five equally well-formed incisors in the lower jaw. Whether the supernumerary tooth is a central or lateral cannot be determined by the form. Coleman records a case having four well-formed central incisors in the upper jaw. Partially developed additional incisors are

Fig. 91.

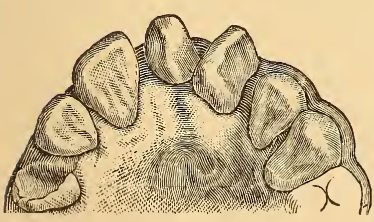
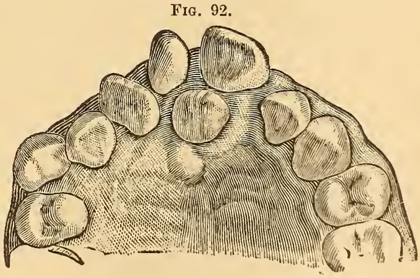


Fig. 92.



not rare. These teeth are found at different angles. They are seen erupting behind the arch, in front of it, or between two other teeth. Fig. 91 shows a conical tooth between two ill-shaped centrals, one

of which stands almost at right angles with the arch. Another case still more interesting (Fig. 92) has two central monstrosities separating the legitimate centrals. Fig. 93 shows two supernumerary cen-

Fig. 93.

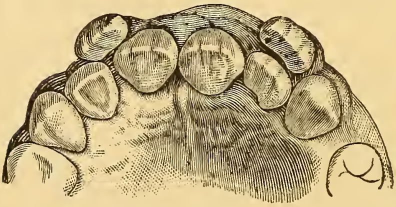
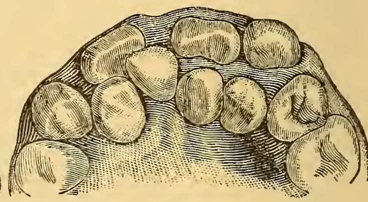


Fig. 94.

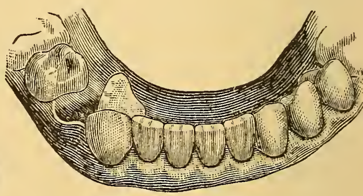


trals having the appearance of being convoluted, between the usual centrals. In Fig. 94 we see two supernumerary central teeth between the laterals, all of which are placed inside the regular arch.

Laterals in excess are not so common as centrals. These are usually more like the normal teeth. Sometimes they are found on

Fig. 95.

Fig. 96.



both sides. Fig. 95 shows a lateral behind the arch and between the central and the lateral. In the lower jaw they are rare.

In Fig. 96 one of the supernumerary laterals is placed back of the

Fig. 97.

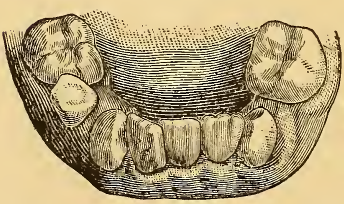
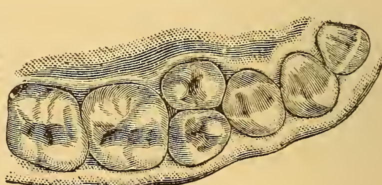


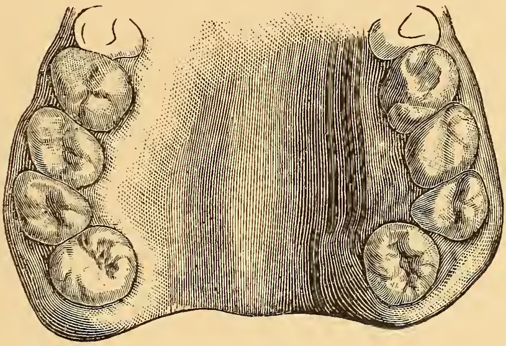
Fig. 98.



right cuspid and at right angles with it. The author has two models similar to this in his collection. Cuspids, bicuspids and molars are not often found in excess.

Fig. 97 shows a supernumerary cuspid, twisted upon its axis on the right side of inferior maxilla. The right lateral is missing and the cuspid is, no doubt, a malformed lateral, although it has the ap-

Fig. 99.



pearance of a perfect cuspid. In Fig. 98 we see a dental anomaly to which attention is directed by Dr. Rickey, of San Francisco. In this case it is difficult to say which is the supernumerary tooth. Fig. 99 shows four well-formed molars in each side.

Fig. 100.

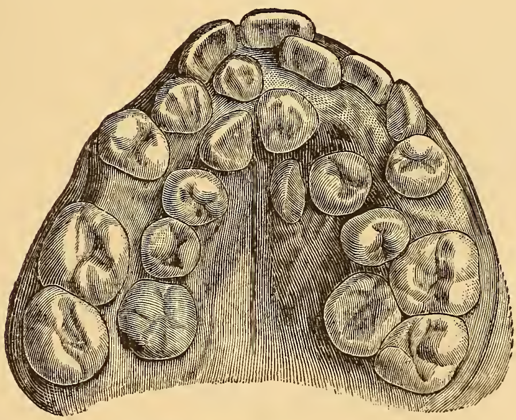


Fig. 100 illustrates a very rare case of supernumerary teeth, eight in all. They do not seem to be confined to any one class, incisors, cuspids and bicuspids seem to be duplicated. This cut certainly illustrates a double set of teeth. The model is in the Pennsylvania College of Dental Surgery.

CHAPTER XII.

THUMB AND FINGER-SUCKING AS A CAUSE OF IRREGULARITY.

In the chapter on refutation of old theories regarding the etiology of irregularities of the jaws and teeth, the author has stated his reasons why the high vault and the V and saddle-shaped arches cannot be ascribed indiscriminately to thumb-sucking, as has been the custom.

Hitherto the greatest confusion of ideas has been current among practitioners as to the etiological differentiation of these cases. It behooves the author to describe the conditions that are due to thumb-sucking in such a way that the student may be aided in making a diagnosis. In cases of irregularities due to thumb-sucking we find several teeth and the alveolar process brought forward. Frequently spaces are found between them, so that they stand out more and more fan-shaped. The vault may be high, but is usually low like that seen in Fig. 103. The teeth are frequently affected only on one side, the shape and extent depending upon the direction of the force and the hand employed in sucking. In the V-shaped arch the teeth are crowded and point toward the centre, owing to a force applied by the posterior column and spent on both halves toward the median line. The vault may or may not be arched. In the saddle-shaped arch the teeth are crowded, except in cases due to hypertrophy, and they stand perpendicular. The vault may be high or low. In cases of thumb-sucking, the teeth of the inferior maxilla do not articulate properly with the upper, and are often turned inward, which is caused by the pressure of the thumb upon the cutting-edges. We see from this that the distinguishing feature of a case of thumb-sucking is the spreading of all or a part of the anterior teeth, and that the lower teeth are usually turned inward.

When the vault is high, it is quite marked in the anterior portion of the roof of the mouth; but this is by no means a characteristic feature. As the habit of thumb-sucking usually terminates before

the eruption of the permanent teeth, cases of irregularities resulting from thumb-sucking in children over ten years of age are rare. (It will be of interest to the student to note a number of cases that have come under the observation of the author.)

Babies usually commence to suck their fingers within a few hours after birth,—in the majority of cases not later than the first week. The habit is therefore well fixed before the temporary teeth begin to erupt. This being the case, the teeth and the alveolar process are naturally affected in their development if the pressure is continuous. The extent, shape and location of the irregularity depends upon the hand employed and the position of the thumb and finger used. The right or left side are affected according to the hand used, though occasionally we find it in the median line.

As the child usually discontinues the habit before the time of the eruption of the permanent teeth, deformities produced by thumb-sucking are usually confined to the temporary set.

Fig. 101 shows the forward movement of the right central and lateral incisor. The model was taken from an impression of the teeth of a little girl two and a half years of age. While in the act of sucking, the right arm rested upon the breast, and the ball of the thumb was directed against the palatine surfaces of the incisors, which were carried forward. The child discontinued the habit at four. It will be observed that while the cutting-edges of the teeth have been slightly pressed forward, and a very slight impression has been made on the alveolar process, none was made on the roots of the teeth, and consequently no deformity exists where the germs of the permanent teeth are located. After the child discontinued the habit, the teeth soon returned to their natural position, aided by the pressure from the lip. At this age the absorption and deposition of bone-cells is so active that very marked deformities are frequently corrected before the temporary teeth are lost, providing that the habit ceases in infancy.

Fig. 101.

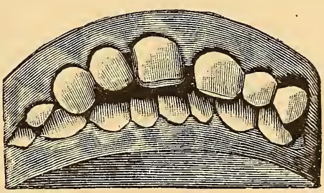
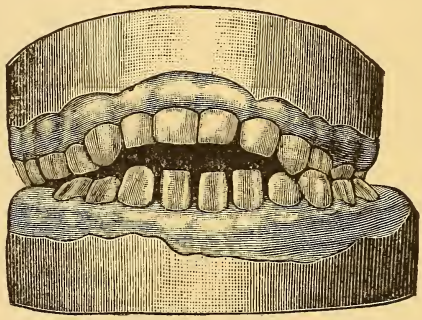


Fig. 102 shows quite a different deformity. Here we see the teeth fully developed, but a marked deformity existing at the median line. This case is that of a child six years of age. The thumb was

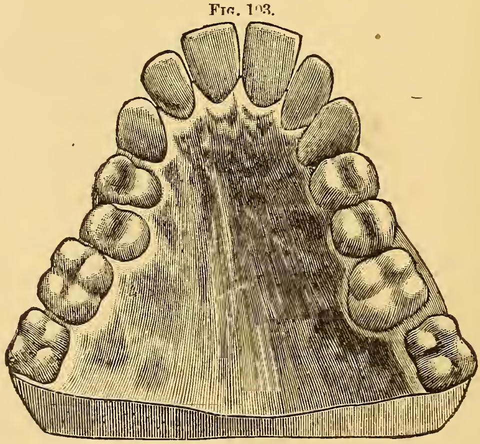
held in the mouth so that the teeth came in contact with the thumb at right angles, preventing the development of the alveolar process. The teeth of the inferior maxilla do not articulate properly with

Fig. 102.



those of the superior, which is caused by the thumb having rotated upon the lower teeth after the upper had closed upon them. The hard palate was flat and normal, showing that the pressure was direct upon the teeth, and that the thumb did not come in contact

Fig. 103.



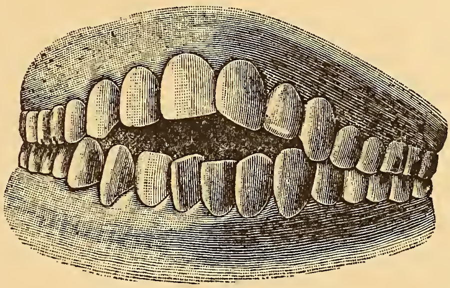
with the tissues of the mouth. When the habit is continued during the development of the permanent set, the deformity is more marked because there is more leverage, as is shown in Fig. 103. This is a case in which the palate is flat and normal, showing that the pres-

sure was direct upon the teeth, and that the thumb did not come in contact with the tissues of the mouth. The superior jaw and teeth are brought forward by absorption and deposition of bone-cells, and the lower teeth and jaw are carried inward.

These cases are so unlike those of any other form of irregularity of the permanent set that it would seem impossible to overlook the cause. The alveolar process and teeth assume the shape of the object or thing sucked.

Fig. 104 shows the front view of a case of thumb-sucking. The teeth have developed their normal length; but arrest of the development of the superior alveolar process has taken place similar to

Fig. 104.



After Wilson.

Fig. 102. In Fig. 104 there has been quite a protrusion and forward movement of superior incisors and alveolar process, the teeth standing fan-shaped. The lower incisors are pressed inward and crowded together. The space is greater on the right side than on the left, showing that the right hand was used.

PART II.—TREATMENT.

CHAPTER I.

PRELIMINARY CONSIDERATIONS.

I. DIAGNOSIS.

Frequently when a case of irregularity is presented we can tell by the general contour and profile of the face whether the case is one of the constitutional type, the external proportions being affected by a decided V-shaped arch, excessively developed alveoli or underhung jaw. One of the first things a dentist has to learn is to observe carefully. In determining the correctness or incorrectness of the outline of the mouth and jaw he instinctively takes it in as a whole on the same principle that when we look at the picture of a friend we decide at once whether it is a good likeness or not, reserving our judgment of particular points until later.

Observe each jaw. See whether it has a normal outline or whether it belongs to the V-shaped or saddle-shaped variety. Notice the vault. These are important points in deciding what appliances can be used. Examine the occlusion, letting the patient open and close his mouth slowly. No detail must go unnoticed. The beginner should familiarize himself with the individuality of each class of teeth, both as to outline and occlusion. For this purpose he is advised to study the very excellent article by Drs. E. T. Starr and F. L. Wise, in the August number of the *Cosmos*, Vol. XXXI.

When there is an asymmetry of the upper and lower jaws, one being larger than the other, the occlusion from the cuspid back is usually wrong. In such cases it generally strikes in front of the lower cuspid, instead of between it and the bicuspid, disarranging the articulation of every tooth back of it. We cannot stop here to speak of the different forms of mal-occlusion; the dentist who never ceases to be a student will see these for himself.

The difficulty in local irregularities is usually detected with readiness, for it is either found in the alveolar arch or the mal-position of individual teeth.

Before giving your opinion inquire into the family history. While I cannot agree with Kingsley that it is useless to try to correct an irregularity peculiar to a family type, nature reverting to her original design, notwithstanding long-continued efforts, yet it is oftentimes well to wait until the patient is of an age when it can be determined what permanent form the jaw will assume. Many cases can be modified and thus be made less unsightly, even if the difficulties cannot be wholly overcome.

The first examination is supplemented by a study from the model which is considered later on.

In making a prognosis the extent of the deformity must be taken into consideration. There are numerous cases that nature will correct without interference on the part of the dentist. Thus cuspids and bicuspids quite frequently erupt out of position, but gradually find their proper place.

Apparent deformities are common during second dentition, while some of the deciduous teeth are still in position; the difference in size between the two sets of teeth and consequent mal-occlusion alarms persons who are not familiar with these deformities, while time will bring about harmony.

One must exercise caution in making a statement as to the ease or difficulty of correction or the time required, as many a case that seems to present no difficulties will give much trouble, because the resistance cannot be determined. Time spent in a careful examination of the case is well spent. Haste may produce embarrassing results. Therefore every particular in the deformity must be studied, and the dentist must forecast in his mind the appliances that may be used, the different steps to be taken and the time required before he can make a prognosis with approximate correctness.

II. AGE.

On the average, however, it may be said approximately that the best time for interference in the majority of cases is from the twelfth to the fourteenth year. At this time—the transitional period between childhood and puberty—all of the teeth are erupted, general nutrition is most active, the osseous system is in the constructive stage, and the

formative process is in vigorous operation. At this time, also, the roots of the teeth are not fully developed, but are more or less loosely confined within the alveoli, and the apical foramina are large, thus lessening the liability of impairment of the blood supply and consequent destruction of the pulp.

The conditions mentioned as existing at the twelfth to the fourteenth year, being coincident with the completion of the eruption of the teeth, it naturally follows that the reverse holds true; hence, in any case in which the teeth are fully erupted we may proceed to operate, irrespective of the age of the patient.

The probability of a perfectly satisfactory result in regulating decreases yearly after the age of puberty, and after the age of twenty-six the chances of a really satisfactory result are very meagre; for at this time the entire osseous system is fully developed, and there is little probability of extensive deposit of ossific material. It is possible to regulate deformities, even as late as the thirtieth year, but the resulting pain is so severe, and the mechanical force necessary to produce absorption of the obstructive portions of the alveoli is so great, that the end hardly justifies the means. When regulated so late in life, retentive and corrective plates must be worn for years to hold the teeth in place until ossific material shall have formed to retain them in their new position.

In some cases of late correction, absorption of the alveolar process not being followed by compensatory ossific deposit, the mechanical interference produces chronic inflammation of the peridental membrane, *i. e.*, a veritable pyorrhœa alveolaris and excessive absorption of the gums and alveolar process had been produced. I observed this very condition in the mouth of a lady of thirty-five, in whom an extended and, I may add, ill-advised operation had been performed. If the teeth must be regulated at this period of life, the operation should be conducted with great caution, and the patient should be duly impressed with a doubtful prognosis. When the patient insists upon an attempt at regulation, and is willing to assume the responsibility of failure, we are perhaps justified in operating in any case of reasonable age.

It must be borne in mind that the physiological process of regulating teeth differs from the repair in cases of fractures of the osseous system, which, under favorable conditions, is possible up to advanced age. In the osseous system two parts of homogeneous

structure are united. Not so in the case of correcting an irregularity. Here the root of the teeth, a dense structure, is enclosed in the spongy structure of the alveolus. The nutrition in the alveoli is extremely active during first and second dentition until the roots are perfectly formed—that is, up to the twentieth year. After that, the blood supply being less, when the alveolus is injured, waste and repair do not go on so rapidly. Nutrition is lowered, as is shown by the separation of teeth and recession of gums in some cases of rapid wedging, as well as in cases of pyorrhœa alveolaris. That the attachment of a tooth to the alveolus later in life cannot be compared to the union of a fractured bone is evident from the fact that teeth, where regulated, are apt to return to their original position unless kept in position by an appliance for a time, and aided by proper occlusion, because the new tissue is not as strong as the original tissue, while, on the other hand, the bones and cicatricial tissue are made of the same material.

III. STATE OF HEALTH.

Having considered in detail the proper period for regulating, we are confronted with another question of perhaps as great importance, viz., the general health and constitutional peculiarities of the patient. Inasmuch as the majority of cases for regulation are youthful, this matter of the general health is no slight consideration. It is an unfortunate fact that the most favorable period for operation is one of the most critical in the life of the patient, so far as the general health is concerned.

From the age of twelve to sixteen, the rapidly-growing boy or girl is subjected to many physical changes, entailing profound disturbances of the general and trophic nervous systems. Prolonged and injudicious hours of study, over-exertion, bad air, improper or insufficient food, sexual irritation, and many other disturbing elements are apt to become prominent factors in the daily life of the patient.

The matter of sexual disturbance is of especial importance in females, on account of the new function—menstruation—which asserts itself at this period. When we superadd to these physiological perturbations and circumstances of environment, the perversion of nutrition consequent upon congenital weakness, rachitis, hereditary syphilis or the exanthemata, the important bearing of the condition

of the general health upon our operative procedures is very manifest. We should defer operating, therefore, on young persons in delicate health until such time as they have become improved by proper treatment; and it behooves us as scientific dentists to know something of these general conditions, so that we may, in all conscientiousness, place them in proper hands for constitutional treatment.

Unfortunately, the patients that present themselves are mostly neurotic, as has been pointed out in Chapter X. on Etiology. This complicates the dangers arising from careless procedures. It is of the utmost importance that the assimilation of the patient should be normal. It is the dentist's duty to inquire into this. The patient should eat sufficient plain, nutritious food that is not stimulating. In many cases it becomes difficult to do this, as the appliance may hinder mastication. He should have an abundance of sleep in a well-ventilated room and should be in the open air as much as possible. The mind should be placid and agreeably occupied. There is nothing like this to aid him to forget the irritation during the process. Repression of pain is as great a tax on the nervous system as the pain itself. Parents and dentists should therefore not be satisfied with the fact that the patient says nothing. He should be encouraged to give expression to his feelings if he is of a reticent disposition, for this is an aid in deciding the amount of time required for each step.

To carry out the program it may be necessary to take the patient out of school or to diminish his tasks. School is a place where it is difficult to obtain fresh air; exercise is almost impossible. Such a patient cannot be brought under the necessary discipline of the school-room without detriment to his health and spirits. School-life, in itself, is a heavy tax during the period of development; to add the strain of correcting an irregularity to his other cares is cruel. Girls should receive especial attention. Many of them are morbidly conscientious and ambitious and unduly reserved. They suffer much and say little. They do not find the relief that boys do in play out of doors. The sights and sounds in field and woods, and even the street, that furnish diversion to the active boy, are denied the girl. Her life is more circumscribed, hence more subject to passive suffering. Great wisdom and judgment are required in such cases.

It is in just such cases as these described that the co-operation of a

skillful physician is indispensable. A case was recently noted in this city where, from a prolonged operation in regulating, a delicate, puny lady was invalided for two years, solely by the shock produced upon a nervous system primarily unstable.

IV. DESIRE FOR CORRECTION.

Success in dentistry as well as in medicine depends to some extent on the attitude of the patient. The mysterious influence of the mind over the body can be made a great aid in accomplishing an operation or else it may be a decided drawback.

Knowledge of human nature, quick sympathies, an agreeable presence and tact are among the most valuable possessions of the operator. If we work in harmony with the laws of health, half is gained. With the aid of these qualities we will be more likely to gain the co-operation of patient and guardian.

Desire for correction depends somewhat on the social status of the patient, sex and age. The very poor, even if they have a decided æsthetic sense, are so hampered with pressing considerations of a more urgent nature that they will pay little attention to an irregularity. With the well-to-do this is quite different. The ornamental side of life assumes larger proportions. Beauty is of the greatest importance, especially to women. Their lot in life may be materially changed by an attractive mouth. It is not for us to question the right or wrong of this state of things; we must consider simply facts. Society takes these things for granted and acts upon them. This being so, the dentist is more likely to secure the co-operation of the child of the well-to-do. Since the daughter of Dives subjects herself most cheerfully to the torture of compressing her waist, she will with equal readiness subject herself to the irritation of correcting a deformed arch, and with much better reason. The mouth, with its ample opportunity for display in its various moods of repose, conversation or laughter, suffers less from the ravages of time than the waist. Mothers are usually keenly alive to these considerations and encourage their children to endure the strain. Occasionally, however, there are parents who, by their indifference or careless remarks, become a great hindrance to the dentist. They do not cooperate with him by seeing to it that appliances are worn and that visits are regular. From these considerations it follows that the dentist should find out what the attitude of patients and guardian is

before he undertakes the task, for without their co-operation his best efforts will be thwarted and his reputation even may suffer.

V. IMPRESSIONS OF THE MOUTH, AND MODELS.

Taking the impression of the mouth and jaws is, of necessity, the first step in regulating the teeth. To secure a counterpart of the mouth sufficiently accurate for reference and study, so that when a model is examined it will show the exact contour of the irregularity, requires much care. The position of the teeth, their relations to one another, and the conformation of the jaws can be more easily studied, and accurate conclusions more readily deduced, from the cast than from an examination of the mouth itself. It is not only essential that the teeth should be moved to their proper places, but they must be in harmonious relations to one another; otherwise, they will be inclined to return to their faulty positions; and their normal relations can best be determined by studying the model.

Impressions may be taken in plaster of Paris or in the modeling compound, but the material employed should depend to a great degree upon the shape of the jaw and the position of the teeth. If the teeth are but slightly irregular, or if the crowns are short and quite irregular, plaster of Paris should be used, as it can be removed from the mouth with but little disturbance of the impression.

If, on the other hand, the teeth are irregular and long, and the arch deep, plaster of Paris will be apt to adhere to the teeth; in this event only the impression cup will come away, and, as a consequence, the plaster will have to be cut out. In such cases the modeling compound should be used.

Where the plaster is used the patient should occupy an ordinary chair instead of the operating chair, as the head is lower and the operator can have better control of the patient. Protect the clothing by placing two towels under the chin and a newspaper in the lap. Select an impression cup large enough to enclose the teeth, and build it up with wax so that it will extend beyond the margin of the gums; fill the centre of the cup with soft wax to conform to the palate; and the plaster will be readily carried to all parts of the mouth. Take a quantity of the finest quality of plaster, and mix it in a bowl with sufficient water to make a mixture of the consistency of thick cream; the addition of a little salt will hasten the process of setting. After stirring until the air bubbles have disap-

peared and the plaster has begun to set, fill the cup and outer edges with it.

The operator should stand to the right of and just behind the patient, with the left arm around the left side of the head, and the forefinger inserted into the mouth. Carry the cup to the mouth with the thumb and forefinger upon the handle and the middle finger in the centre to steady it, and after it has been inserted into the mouth, with a rotary motion of the right hand press it into place, at the same time raising the lip and pressing out the cheek with the left finger. When the cup is in position, hold it firmly with the middle finger in the centre of the plate against the teeth. Incline the head towards the breast to prevent the plaster passing back to the fauces. Should the stomach become disturbed and vomiting ensue it can be evacuated without interfering with the impression.

Test the plaster in the bowl or on the impression cup, and when it will break with a clean fracture it is time to remove the cup, which can be done by moving the cup backward and forward with the right hand, and pushing out the cheek with the fingers of the left hand to admit the air. Having placed it in the upper towel, held up by the assistant, carefully examine the mouth, and if pieces of plaster are seen, put them in the towel on the proper side of the impression to save time, and set it carefully away, afterwards arranging the pieces in their right places in the impression.

The second towel is for the purpose of removing plaster that may remain about the face.

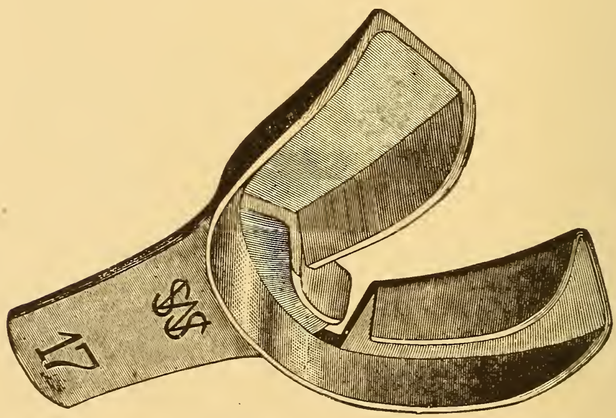
It is well to explain something of the operation to the patient, as one would naturally anticipate a more serious experience than is actually realized. All of these little details should be strictly attended to, in order to insure a perfect impression at the first sitting, and thus save the patient the annoyance of several applications.

In taking impressions of the lower jaw the patient should sit higher, so that the mouth will be on a level with the elbow of the operator, who stands in front of the patient; the fingers of the left hand should push out the cheeks and lips while the cup is rotated into place with the right hand. The first and second fingers of each hand should rest upon the cup over the bicuspids and molars, the thumbs under the jaw on either side, thus holding the cup firmly in place until the plaster sets, when it should be removed and placed in the towel as before. After a few minutes'

hardening, the impression should be placed under running water to remove mucus, saliva, blood or particles of plaster. Should the plaster be broken, the pieces can be placed in the positions indicated by the arrangement on the towel, and, when perfectly dry, fastened together by melted black wax. A clean separation of the model is obtained by covering it with a lather of soap and washing off the surplus, or by coating with shellac and oiling to prevent sticking.

The author has used modeling compound with success by heating water to the boiling point and then pouring it in a bowl containing modeling compound. The compound should be in-

Fig. 105.



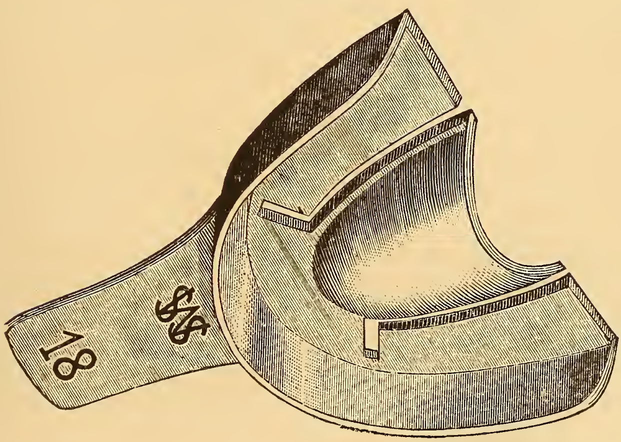
serted as hot as it can be borne; enough should be used to cover all parts of the teeth and jaws when it is forced into place. The impression cup should be held firmly in place for a moment, and a towel saturated with cold water should be carried to all parts of the mouth to chill the compound. S. S. White's upper and lower impression cups, No. 17 and 18, such as are illustrated in Figs. 105 and 106, should be used in taking impressions in cases of irregularities. The compound loses its elasticity by boiling.

It is a good plan to oil the surface of the impressions, thus preventing the compound sticking to the cast.

To obtain the model, place a sufficient quantity of water in a bowl and pour in plaster, allowing it to settle, and thus prevent-

ing the formation of air bubbles; add enough plaster to make it of the consistency of cream. Put a drop of water into each depression made by the teeth in the impression, to exclude the air, and add a small additional quantity of plaster. By tapping the cup upon the bench the plaster will fill up the depressions without the formation of air-bubbles; the surface should now be covered with plaster, and after mixing in more dry plaster to make it thicken, fill the impression full and place it upside down on a glass slide. Now build out the model until even with the impression cup, and allow it to harden. It is better to let it stand from twelve to twenty-four hours, that it may become thoroughly hardened before being removed.

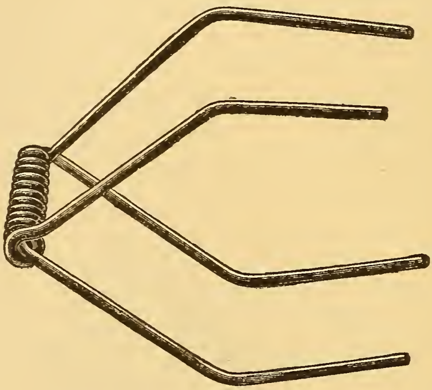
Fig. 106.



Having removed the impression, trim the model roughly, and after articulating, trim it so that the body of the model will be parallel with the line of the teeth, and made presentable for inspection. Place the name of the patient and the date of the time the operation was begun on the surface of the lower model, and the patient's initials upon the upper model, after which the surface should be varnished. A band of elastic rubber will hold them together, or make an articulator of brass wire, as illustrated in Fig. 107 for the purpose of holding the models in their proper positions, thus preparing them for easy inspection. The upper arms and spiral are made of one piece of wire, No. 18, U. S. gauge. The lower arms are made from another piece of the same wire passed through the spiral and

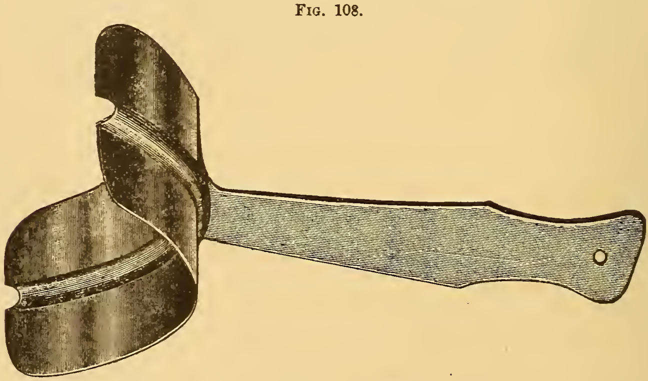
bent to correspond to the upper arms. The models are now articulated, and the wire arms bent to meet the upper and lower surfaces. The surfaces, after being saturated with water, should be covered with plaster and the arms united to the model.

Fig. 107.



The cups for taking impressions of the anterior teeth, illustrated by Fig. 108, and for the molars and bicuspids, Fig. 109, together with suggestions for their use, were devised by Dr. Wm. P. Cooke, of Boston. He prepares a sufficient quantity of wax, and after

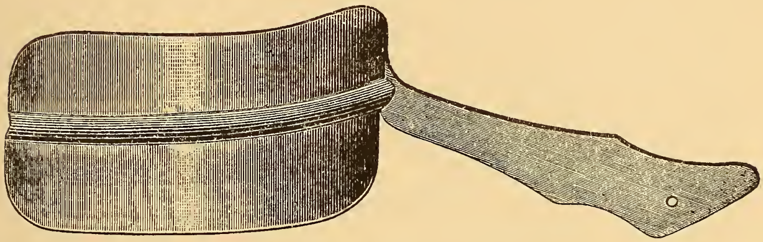
Fig. 108.



warming it, places it upon the cup. When the jaws are in a normal position, and the saliva and mucus removed from the teeth and mucous membrane, the cup with the wax is forced between the lips and against the teeth and cooled with a wet napkin. The patient is

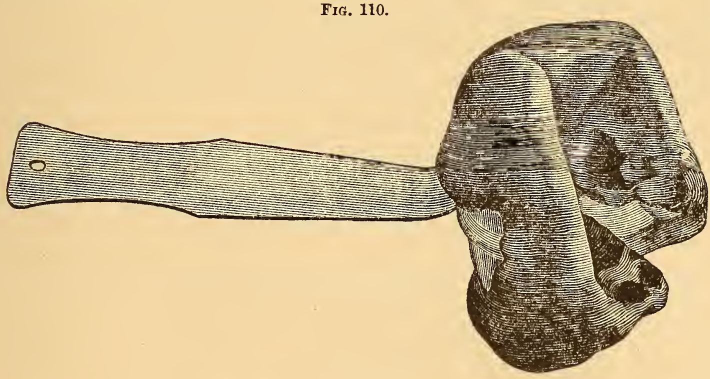
requested to open the mouth, when the impression is removed, as shown in Fig. 110. The model, Fig. 111, is obtained by pouring plaster into both upper and lower impressions, thus making a solid model. This is a very desirable way of procuring an accurate and permanent model of the mouth when one is needed for observation

FIG. 109.



and study. It will save time to put them in a place convenient for reference, which receptacle should, of course, be a safe one. The models should be examined from time to time, to note the progress of the operation.

FIG. 110.



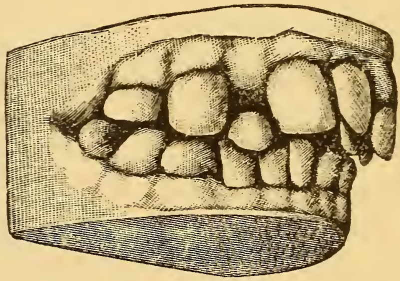
VI. THE STUDY OF MODELS.

It is important in regulating teeth to have a model conveniently near at hand to be able to improve spare moments by studying it, and thus become thoroughly acquainted with the physiological conditions of the teeth, before attemping to come to conclusions regarding the pathology of the case. In determining the character and extent of a deformity some criterion is necessary. In the human

skull, taking the two cuspids for our starting-point, we find the arc of a circle, and by dropping a line from the cusp of the cuspid to the center of the wisdom-tooth, we see that the posterior part diverges considerably from the central line. Thus, Fig. 112 shows the three normal lines of the dental arch.

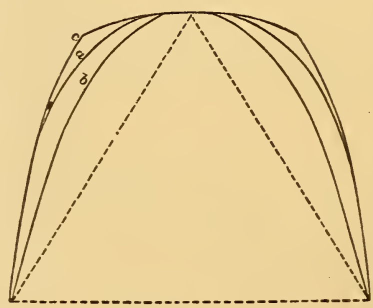
The incisors of the inferior maxilla should close inside of the

Fig. 111.



superior incisors, and the buccal cusps of the bicuspids and molars should occlude at the centre line or sulci of the superior biscuspids and molars. If we hold the articulated skull in our hands, with the buccal surface toward us, we will observe a gentle curve downward from the cuspid to the second bicuspid, then rising until the wisdom

Fig. 112.



After Farrar.

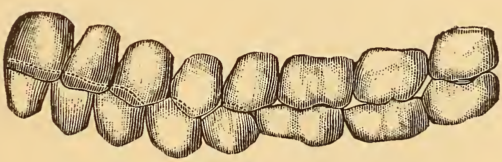
teeth are reached; thus, Fig. 113 not only shows the relative positions of the teeth in the jaw, but their rélation to one another. As mastication is done principally by the bicuspids and first molars, it is necessary that these teeth articulate perfectly, which is accom-

plished by the tooth of one jaw interlocking between two teeth of the opposite jaw, thus providing support and surface.

If the arch posterior to the cuspids be uniform, and these teeth are regular and articulate as shown in the cut, they should not be interfered with for a slight deformity existing in any of the six anterior teeth. The cuspids may be spread laterally to make all the room necessary. When this is accomplished and the deformity corrected, all the teeth in the arch will adjust themselves properly. If the irregularity be complicated, and more room required than can be obtained by spreading the cuspids, it is best to enlarge both arches; this will give all the space needed. To change a well-articulated set of teeth so that the cusps of the opposite teeth will strike would be unpardonable.

The arch of the superior and the inferior maxilla should have a

Fig. 113.



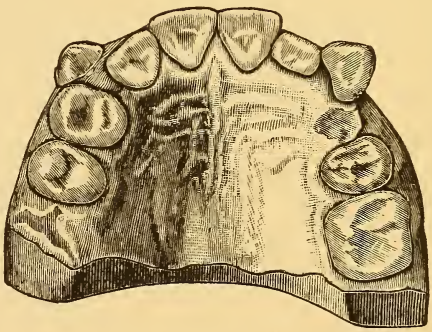
diameter of sufficient width to prevent an impression of the teeth on the sides of the tongue. Any deviation of the jaws or teeth from this outline is considered a deformity, and should receive the attention of the dentist.

Examining the model with this ideal in mind, we find certain deformities, and the question arises how to treat them. Before proceeding, we will decide, on careful consideration, that one of two conditions exists: either the teeth are in a crowded and irregular condition inside of the proper line, or they are isolated and irregular outside of the line. In the majority of cases the irregularity involves the teeth anterior to the first permanent molars. If space be wanting, the question will arise whether to enlarge the arch by force, or to extract one or more teeth, and thus give the required room. The age of the patient will, to a certain extent, decide this question. If the temporary teeth are in the mouth, causing irregularities, they must be removed. When the removal of the second

teeth becomes a necessity, a tooth should be selected which is the least prominent or which will least affect the expression. A good rule is to retain, if possible, the six anterior teeth. As the cuspids are the most prominent and give expression to the face, they should never be removed; but if one must be sacrificed, the selection lies between the first or second bicuspid and the first molar.

If we find on examination that the teeth are decayed (at the age of twelve or thirteen years it is common to find the first permanent molar decayed), those affected should be extracted if the crowns are wholly or partially destroyed. In the model of the upper teeth of a girl fourteen years of age (Fig. 114), the bicuspids are seen to have

Fig. 114.



advanced so far forward that there is insufficient space for the cuspid to come down into place. Upon examination of this case it was found that the first bicuspid upon the left side and the first permanent molar upon the right side were badly decayed. It was easy to decide which teeth should be sacrificed. The cuspid upon the left side came into place without assistance. The bicuspids upon the right side were carried back and the right cuspid came into place. It is probable that in the past the first permanent molar has often been extracted without sufficient cause. As this tooth serves an important purpose in mastication on account of its broad surface, I should advise its retention if the crown be in a fair state of preservation. It has served for six years, which fact, in connection with its solidity in the jaws and its central position, is an argument in favor of keeping it as long as possible.

Upon examining the models of the jaws, we occasionally find the

articulation posterior to the cuspids perfect, with the cuspids nearly approximating the centrals, and the laterals locked inside of the arch. Whether they are sound or decayed, it may be best in such cases to remove one or both laterals. The general appearance of the teeth will not be injured by this treatment. Dr. Guilford, in the "American System of Dentistry," mentions two cases of this kind, as follows: "The writer had two cases in one year presented to him for the reduction of prominence in the superior front teeth. In each case there was a broken or badly-diseased right central that was past hope of redemption. In these cases it did not happen particularly amiss, for the extraction of the roots afforded room for drawing in the remaining five teeth, thus easily reducing the deformity, and at the same time closing the space made by their loss. The appearance of the patient in each instance was greatly improved, and the absence of even so large a tooth as the central was scarcely noticeable.

"In another case, a girl eleven years of age had lost a right superior central incisor through a fall from a swing. Two days after the accident, and when the tooth had been mislaid or thrown away, she was brought for treatment. Only two methods of remedying the difficulty suggested themselves. One was the wearing of an artificial tooth, the other drawing the teeth together to close the space. The latter plan was decided upon, and successfully carried into effect, but, unfortunately, as there had been no protrusion formerly, and there was contraction afterward, the superior teeth no longer overlapped the lower ones, but met them edge to edge, thus giving the upper jaw a flattened appearance which was, in itself, a deformity. The patient was saved the annoyance of wearing an artificial tooth, but her facial expression was injured in consequence."

Irregularities of the inferior incisors are often seen, and if the articulation be normal in the posterior part of the mouth, almost any of the incisors that are out of position may be removed. They resemble one another so closely in size and shape and are so nearly concealed by the lip that their loss will not be observed. The author would suggest that the operator needs to be particularly careful in deciding upon the mode of treatment, as he has seen three cases in which an actual increase of the deformity was produced by a hurried operation. In one of these, a girl ten years of age, a cen-

tral incisor was removed, and the muscles of the lip, together with lateral pressure of the adjoining teeth, pushed against the cuspids, forced the incisors into a crowded condition, thus producing a V-shaped arch. It was ascertained that the articulation of the posterior teeth was not perfect. It has been advised by some authorities to remove a corresponding tooth on the opposite side where want of room compels the removal of a tooth in the anterior part of the mouth. They claim that there is danger of the incisor moving by the median line when a tooth from one side only is extracted; but we have found that when a tooth is removed back of the cuspids, it is seldom that the lateral pressure is sufficient to materially move the incisors.

In considering the bicuspids, the one which is the most decayed should be removed if, by doing so, the irregularity can be corrected. Care should always be exercised in examining the occlusion before a bicuspid is extracted. The author has seen a case where the two upper second bicuspids were extracted with the hope of relieving the crowded condition of the anterior teeth. The articulation of the first bicuspids was such that an adjustment was impossible, these being perfectly interlocked with the lower teeth. No relief followed, and the only way to correct the blunder was to move the first bicuspids back. The mistake was made by following blindly what was vaguely supposed to be the rule without considering the requirements of occlusion.

If both bicuspids are sound, then the first should be chosen if the anterior teeth are crowded. This makes room for the cuspid if this is desirable. In studying the model, the end to be kept in view is the retention of the teeth in place after they have found their new position and are properly articulated, so that they will hold one another in place. If this be not accomplished, the action of the cusps will force the teeth into their original faulty position.

VII. FEES.

In most cases an important consideration in the operation of regulating a set of teeth is the pecuniary reward for it. The specialist in this particular branch should have so prepared himself that he will fully understand and appreciate the requirements of any case which he may undertake to correct. To do this will take much time and anxious thought, for which he should receive a just

reward. A thorough understanding as to the proper remuneration for the operation should be established between the dentist and his patient before anything is done.

The models of the jaws should be carefully examined. The temperament and disposition of the patient, as well as the ossific condition of the jaws, should be considered and minutely inquired into. For it will frequently happen that mouths exhibiting very nearly the same deformity will, on account of mental and physiological idiosyncrasies and great difference in density of tissue, require very different treatment in order to accomplish equally favorable results. After these preliminaries have been carefully attended to, as correct an estimate as possible should be made (and at the best it can but approximate) of the expense of regulating the teeth and securing them in their proper position.

At this juncture, and before any operation is begun, a thorough understanding should be established between the operator and the parent or guardian of the approximate cost of the work. It is well not to be too definite in regard to the matter; for it will frequently happen that the operation will require very different appliances and consume more time than was at first anticipated, in which case the operator should be rewarded for his unexpected labor. Or, the operation may be completed in a much shorter time than was anticipated, in which event a proper regard for the patient's rights should prompt a reduction in the fee. A minimum and a maximum price, therefore, should be agreed upon before the operation is undertaken. Conspicuous among the difficulties which come with regulating is, first, to persuade the patient to submit to the annoyance of wearing the appliance; and, secondly, to impress upon the patient the necessity of being prompt and faithful in his visits to the dentist. Not appreciating the importance of these operations, patients, and especially children, frequently become discouraged, and are anxious to abandon the treatment before it is completed. The parent too often sympathizes with the child, and without regard for the labor or expense which the dentist has assumed, or the real interest of the patient, the operation is abandoned. The dentist is left without remuneration, although up to this point he has carried out his part of the contract. To secure the continued co-operation of the patient and parent until the completion of the operations, it is but justice to

the dentist that he should demand and receive at least one-half of the proposed fee before the work is begun. With this money invested in the operation, the parent will be loth to allow the case to be abandoned before it is finished.

The dentist should, with due regard to the comfort and good of his patient, do all in his power to expedite his operation, so that the suffering and expense may be as light as possible; but whatever he does should be done with an intelligent understanding of the physiological and pathological conditions with which he is dealing. The patient should, by obedience to the dentist's instructions, do all in his power to facilitate the correction, which will, as a matter of course, greatly reduce the expense of the operation. As a rule it will be better not to be too minute in detailing the plans intended to be followed and the appliances to be used in the course of the operation, for it will frequently happen that the most carefully-planned procedure will have to be varied during the operation; in which case disappointment and dissatisfaction might be engendered in the mind of the patient, and lead to a suspicion as to the dentist's ability to accomplish the results at first promised.

CHAPTER II.

PHYSIOLOGICAL AND PATHOLOGICAL CHANGES.

It is apparent, to a close observer, that the teeth are constantly changing their positions in the jaw, absorption and deposition of bone going on simultaneously and continuously. This is particularly noticeable at the first eruption of the teeth, and again from the twelfth to the sixteenth year. When the first permanent molar has been removed the second and third gradually press forward and fill the space.

It will also be noticed that teeth that are erupted out of their position will, in time, often find their way into their proper places; also when the molars and bicuspids are lost late in life the anterior teeth are forced forward, thus causing the alveolar arches to project. Again, it is found that when the anterior teeth come in irregularly they rotate their way into place. These facts indicate that when nature is assisted, whether by mechanical devices or the removal of obstructions, the regulation of malpositions becomes both simple and logical; and, furthermore, that after regulation, the teeth may be firmly retained in their relatively new positions in the alveolar process.

It stands to reason that the application of light, constant pressure to irregular teeth, in connection with nature's own efforts, will greatly enhance the physiological phenomena of absorption and reproduction of bone. Whether these phenomena will proceed equally or not will depend upon the amount of pressure exerted and the condition of the individual, for it is obvious that in cachexiæ of various kinds disintegration is favored, while tissue-building is correspondingly sluggish. This will serve to impress the immediately vital importance of the degree of pressure and the constitutional condition of the patient in various operations of regulating. When the whole of the alveolar arch is spread laterally, and the force is distributed for a distance upon both sides of the jaw, the bones yield to a certain extent, thus spacing the teeth equally in all directions; and by absorption of the old and deposition of the new bone about them, they

become fixed in their new positions. The degree of absorption and change of position is not always equal in all parts of the same tooth, varying chiefly with the direction of the pressure.

When force is applied to the crown, and the tooth has to be moved considerably, there is more absorption at the margin of the alveolus than at its apex. Simple leverage will explain this: the mechanical appliance is the power, and the apex of the tooth is the fulcrum; naturally, the power acts upon the margin of the cavity in which the tooth is imbedded. Or it might be said that the tooth moves like a spoke in a wheel: the outer part of the crown travels a relatively greater distance than the inner part, or apex. The gradual diminution in diameter from neck to apex is also an important consideration.

When the pressure is too great, then absorption is arrested, on account of the inflammation and pain which result. The operator should avoid causing pain, and this is usually possible. When pain does occur, it should warn him that the line of demarkation between physiological and pathological changes is being transgressed by mechanical violence. If the pressure be gentle, evenly distributed and constant, no pain will be experienced after the teeth have once begun to yield in the proper direction. But when the force is applied, removed, and reapplied at spasmodic intervals, considerable pain must necessarily result.

The difference between the effects of steady and those of intermittent pressure is illustrated in every-day practice: where teeth have been separated to facilitate the filling of proximate cavities, the vibration of the teeth caused by preparing the cavity and applying the gold, produces intense pain, which is relieved by inserting a wedge to distend and steady the teeth by its constant and equable pressure. Individual susceptibility must not be forgotten in this connection; for, as is well known, the impressibility to pain and the power of endurance vary with the temperament and condition of the patient. After the age of twenty-five or six the bones contain more of the earthy and less of the animal matter than during the formative and developmental period, and the constructive stage having passed, it becomes more difficult to move the teeth than in earlier life; and, *pari passu*, with the increased pressure required to effect absorption, a greater degree of pain and inflammation is produced.

In these latter cases of regulating, retentive plates must often be

worn, after the malposition of the teeth has been corrected, for two or three years, until a deposition of bone takes place which is sufficiently firm to hold the teeth securely in place. The teeth most difficult to retain are those that have been rotated in the jaw, as they have a tendency to return to their original and faulty positions, even after a lapse of three years. By dispensing with the retentive plate for a day or two, and then reinserting it, any deviation in position can be readily noted.

CHAPTER III.

MECHANICAL FORCES.

In order to do the work with the least loss of time and inconvenience to the patient, it is necessary that there should be a knowledge of the mechanical forces, the powers and limitations of each, and method of application. All forces act either continuously like the lever, or interruptedly like the screw, but, in both cases, their action diminishes with the yielding of the tooth. The mechanical powers are all modifications of two primary principles: the inclined plane and the lever. From these other forces are derived, thus:

1. *The Lever.*	4. The Inclined Plane.
2. The Pulley.	5. The Wedge.
3. The Wheel and Axle.	6. The Screw.

Elasticity, as shown in India-rubber and the spring of metals, although not classified with the primary forces in mechanics, plays an important part in the application of force in regulating teeth. When these laws and their applications are firmly fixed in the mind of the operator, he can readily take advantage of the one which should properly be applied, or, when necessary to apply more than one, can combine them in such a manner as will best accomplish the desired result. The degree and line of force required have much to do with the form of appliances which should properly be used.

APPLICATION OF FORCE.

In every appliance for regulating the teeth the object is the same, viz., to exert pressure upon the teeth to be moved. Any appliance for this purpose should be as small as is compatible with effectiveness and strength. When possible, it should be so constructed that it can be applied inside of the arch in such a manner that it will not interfere with speech or mastication, and can be removed by the wearer for cleansing.

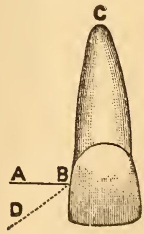
It should give as little annoyance and pain as possible, and should not necessitate frequent visits to the dentist for its adjustment. Whether the teeth are to be forced out or drawn in, there

are always to be considered a body to be moved (the tooth) and a fixed point of resistance.

Study of the model does not always determine the amount of force required to move the tooth. This statement is not made to discourage the study of the model, but to encourage caution. Though usually a point opposite can be chosen for the anchorage of the appliance, this rule does not always hold good. Every case is a problem in itself. The point of anchorage must, of course, afford greater resistance than the point to be moved, and to find such a point is sometimes a difficult manner. Such is the case when a cuspid is to be moved. In such cases it frequently happens that the dentist finds, to his chagrin, he has moved his point of resistance rather than the tooth determined upon. From this it follows that constant vigilance must be exercised in noting occlusion, and the patient should be asked in which tooth he suffers most. It is often found expedient in moving teeth that afford great resistance, like central incisors or cuspids, to loosen them first by simple wedging with orange wood, or even cotton, proceeding slowly. Thus the resistance is lessened and the tooth or teeth to which they are attached will now afford greater resistance in *proportion* than at first.

Sometimes a plate can be constructed to which an appliance for moving a tooth can be attached. This is desirable (1) where there is no tooth conveniently located for attachment, (2) when it is expedient to avoid the additional irritation, (3) when the mechanism is such as to require it. In applying the apparatus to a tooth, its position in the jaw should be observed and the inclination of the root or roots must be ascertained to decide whether they stand perpendicularly in the alveolar process or on an incline. All obstructions should be removed by extraction or by lateral pressure.

Fig. 115.



The force should be applied to the tooth to be moved either at right angles to the long axis of the root (Fig. 115, *a b c*), or at an angle of 45 degrees, *d b c*. By these means the tooth is prevented from rising from the socket. The position of the tooth in the jaw, the density of the alveolar process, the length of the roots, their normal or abnormal condition and length of crowns, will all require consideration in deciding the amount and direction of the force which may be used without elongating the tooth.

If the superior maxillary bone be examined after the teeth are removed, it will be seen that the outer plate of the alveolar process of the superior maxilla is much thinner than the inner plate, which is backed up by the strong, thick bone of the hard palate, while upon the inferior maxilla the outer plate of bone is thinner as far back as the second bicuspids, and the inner plate is thinner at the part occupied by the molars. The inner plate is thickest between the second bicuspids upon either side, and is reinforced by the symphysis and gential tubercles. The external plate is thickest in spaces occupied by the molars, and is backed by the external oblique ridge. When the soft tissues have been removed from the superior maxilla, it is not uncommon to find the roots of sound, healthy teeth extending through the outer plate of bone. After the teeth have been extracted, absorption of the outer plate takes place much more rapidly than of the inner plate. Absorption of the external and internal plates of the inferior maxilla goes on more uniformly than in those of the superior, owing to a more even distribution of bone.

In the application of force, it will be observed that the most pressure is required in the direction of the greatest resistance, and care must be exercised in directing the force toward the weaker parts of the alveolar process.

If possible the force should be uniform and steady, but this is possible only with certain appliances like the elastic band, ligatures and the like, while impossible with the screw. All forces act either slowly and constantly like the above, diminishing in their action in proportion to the yielding of the tooth, or else they act by impulse, like the screw.

The force exerted should be enough to produce absorption of bone without causing inflammation, although in some cases slight inflammation is desired. Here we would discountenance the too rapid movement of teeth, especially when persons are over twenty years of age. I have seen the alveolar process absorbed to such an extent that it was impossible to retain the teeth in their proper places, as new material was not deposited. I would protest decidedly against the drilling of holes in natural teeth for anchorage, as is practiced by some reputable dentists. There are few cases that cannot be treated by securing a band or cap of thin gold or platinum to the teeth with oxyphosphate of zinc, in which holes may be drilled or hooks or loops soldered at any required point.

THE LEVER.

The lever "is an inflexible bar, capable of being moved about a fixed point, called the fulcrum."

The *resistance or weight* is the object to be moved; the *fulcrum* is the fixed point of support; the *power* is the force which overcomes the resistance. According to the relative position of these, we have three kinds of levers:

1. Lever of the first kind: Power—Fulcrum—Weight.
2. " " second kind: Power—Weight—Fulcrum.
3. " " third kind: Weight—Power—Fulcrum.

An example of the first kind is the crow-bar; of the second, the wheelbarrow; of the third, the forceps.

General Law.—*Intensity of force is gained, and time is lost, in proportion as the distance between the power and the fulcrum exceeds the distance between the weight and the fulcrum.*

In using the lever for the correction of irregularities it undergoes modifications. Thus when it is applied in the form of a ligature or an elastic band it becomes flexible instead of rigid, the fulcrum frequently becomes a surface instead of a mere point, and the power is changed into resistance.

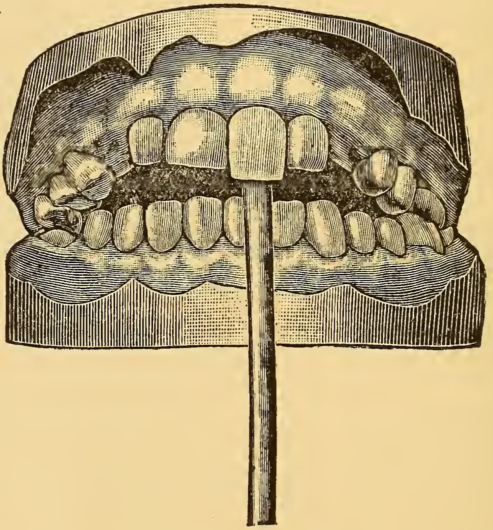
Where the leverage can be multiplied most stubborn cases are obliged to succumb, as is illustrated in rotating teeth set very firmly in the jaw, or those which are crowded closely, or teeth of persons in advanced years, where the alveolar process has become very dense and hard. The increase of power in the lever is obtained by lengthening the rod proportionately or in combining the leverage with another force.

The application of an increased length of rod is limited, for want of space in the mouth; for if above rather limited dimensions it interferes with the tongue or lips. We invariably use the lever in any case in which the anterior superior teeth occlude inside of the inferior teeth, if the case be presented early enough. It is always desirable to regulate these teeth as soon after their eruption as possible, *i.e.*, before the bony tissue becomes dense and hard. Fig. 116 illustrates this simple method.

Here we have a lever of the first kind. The upper incisor that strikes inside is the weight to be moved, the lower incisor against

which the stick rests is the fulcrum and the hand holding the stick is the power. The greater the distance between the hand and the resting-place of the stick the greater the force exerted. As soon as the upper tooth strikes outside the lower the operation is completed on the principle of the wedge. Every time the patient closes the teeth with any degree of force, the wedge (the lower incisors) is

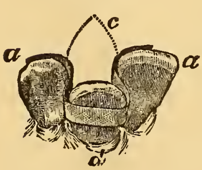
FIG. 116.



driven a little farther under the upper, thus forcing it outward until even with the rest.

Another simple and efficient device, acting on the principle of the lever for bringing out one or two teeth, is a strip of German silver bent at an angle once or twice (Fig. 117). This affords double leverage, inasmuch as it draws one tooth in and the other out. *B* is the *weight*, the proximal surfaces of the two adjoining teeth at *c* are the *fulcrum* and *a* the power, or *a* the weight, *c* the fulcrum and *b* the power. The strongest tooth affords, of course, the greatest resistance and is therefore the power.

FIG. 117.



The resistance or power in cases like this depends largely on the elasticity and tenacity of the metal. If the intervening medium

between the proximal surface of the resisting tooth and that of the tooth to be moved has little or no elasticity, the intervening medium will yield readily, and nothing can be accomplished.

The simplest form of leverage is a wedge of cotton, gutta percha or wood. The yielding tooth becomes the weight, the resisting tooth the fulcrum and the elasticity of the intervening wedge the power. We thus have a lever of the third kind. When cotton or wood are used capillary attraction becomes the source of power, inasmuch as it results in the absorption of moisture.

Leverage depends for its efficiency on the point where it is applied. Judgment and thought exercised in this will amply repay in the time gained and pain saved. In case the tooth *a* is to be brought in, it is a matter of some consequence whether force is applied half-way between the cutting-edge and the neck or at the cutting-edge. The apex of the root always being the fulcrum, the farther from this we can apply it, the better; hence it is desirable to apply it as near as possible to the cutting-edge. A tooth with a long root furnishes the advantage of distance from the fulcrum, which is, however, more than counterbalanced by the additional resistance thus offered, as it is easier to move a tooth with a short root.

THE PULLEY, WHEEL AND AXLE.

The pulley is a wheel with a groove cut into its circumference, and is movable upon its axis. In mechanics the common term for pulley is sheave. The pulley or sheave is placed between the oblong blocks of wood through which the axis passes and supports the pulley in the centre. The cord passing around the pulley is called the tackle. The bucket and weight in the old-fashioned well illustrate the pulley. The wheel and axle is a modification of the pulley. The wheel is fastened securely to the axle; the weight is attached by a rope to the axle, and the power by a rope to the wheel or to handles fixed at right angles to its rim. The steering-gear of a vessel is an illustration of this kind of lever.

The wheel and axle and pulley are modifications of the lever of the first kind, the circumference of the wheel or pulley corresponding to the long arm; the axle or block to the short arm, the axis in both cases the fulcrum. The general law corresponds to that of the lever.

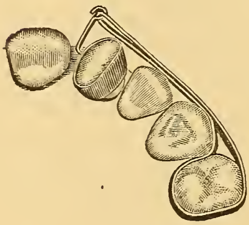
LAW.—*Intensity of force is gained and time is lost in proportion as*

the circumference of the wheel exceeds that of the axle. The advantage of the wheel and axle over the simple lever is the change of direction of power which it affords. The power, instead of being in the same straight line with the fulcrum and weight, may be applied at an angle. This is convenient in producing the rotation of a tooth.

In its application to regulating, the elasticity of the rubber band is the power; the tooth or teeth over which it passes is the fulcrum, and the tooth to be moved the weight.

Fig. 118 illustrates the rotation of a tooth by having a gold band with an arm fitted to the tooth, and a rubber band attached to the arm and stretched to the first bicuspid; as the tooth rotates, the arm is bent at right angles to the band. This application of the wheel and axle will accomplish the rotation of the teeth in the majority of cases. The difficulty lies in the retention of the teeth after they have been forced into their proper position. The younger the patient, the easier this will be accomplished.

Fig. 118.



It should be observed that the power of an elastic band is increased with the tension until this becomes greater than the strength of the material, when it will break. Hence the greater the number of teeth over which it passes, the greater the power of the same band; but at the same time it is lessened by the friction of the surfaces over which it passes.

THE INCLINED PLANE.

The inclined plane—a plane surface inclined to the horizon at any angle—is used for raising weights. The longer the inclined plane the easier it is to raise a body a given height.

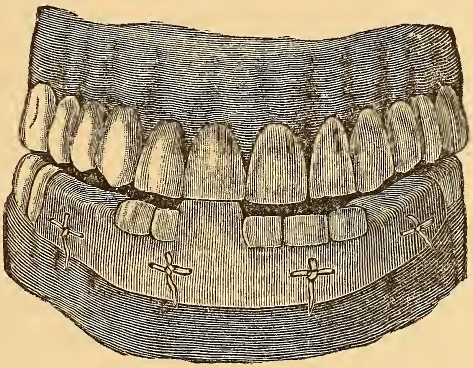
General Law.—*When the power acts parallel to the inclined plane, intensity of force is gained and time is lost in proportion as the length of the plane exceeds its height.*

In its application to dentistry this force is of especial value in cases in which the arch is to be widened by an appliance; under such circumstances the teeth exert an outward pressure on the opposite jaw, and the articulation of the cusps makes an inclined plane.

If the anterior superior teeth close inside of the inferior teeth

they should be brought out with the lever, and if the inferior teeth are too short to exert a pressure on their opponents, they may be fitted with a platinum cap and cemented securely with the oxy-phosphate of zinc. This arrangement will maintain a constant outward pressure upon the superior teeth. Fig. 119 is another illus-

Fig. 119.



tration of this principle. In this case a metal plate is fastened to the teeth by a ligature instead of an elastic band.

THE WEDGE.

The wedge is a modification of the inclined plane. The power is applied with a hammer or a sledge to the back of the wedge. It is employed in various ways in ordinary mechanics, as in raising buildings, splitting wood, etc. It is an unsatisfactory force to calculate upon, because the large, flat surfaces produce so much friction. On the other hand, its friction is useful in retaining the wedge in its position.

Law.—*The power* (acting parallel to the base instead of the inclined surface) *counterbalances a weight as many times greater than itself as the height of the wedge is contained in the base.* When applied to the teeth, the wedge increases the diameter of the arc of a circle in which the teeth are implanted. It is usually made from a fine-grained wood or of India-rubber. It is a direct and positive force, and is very effective. Teeth with long roots, which are set deep in the alveolar process, when the latter is dense and hard, are difficult to start with ordinary regulating appliances. In such

cases the wedge is of great service. It will readily move one or two teeth, and not infrequently three will be influenced by its pressure. Wedges made from orange wood are found to be very serviceable, as they can be readily reduced in size as the case may require. When applied to the teeth they become saturated with saliva, swell, and in so doing force the teeth apart. When a rubber wedge is used we select one slightly larger than the space between the teeth, and by its elasticity the teeth are spread. The rubber wedge performs its work with greater rapidity, perhaps, but it causes more pain than the wooden wedge. Owing to the elasticity of the rubber the teeth vibrate with each effort of mastication, whereas they would be held firmly by the wooden wedge.

THE SCREW.

The screw, another of the mechanical powers, is also a modification of the inclined plane, and always requires a lever for the purpose of turning it. It may be used for penetrating wood, like a thumb-screw, a gimlet, etc., or it may be used as a moving force, as in raising buildings or in the familiar letter-press. In these cases it must work in a hollow cylinder with a corresponding thread cut inside, which is called the female screw, or nut. When the screw is turned in the nut, it will either advance or recede.

LAW.—*With the screw, the power produces a pressure as many times greater than itself as its circumference is greater than the distance between the threads.*

It should be noticed that, unlike the other mechanical powers described, the screw works by impulse, each turn producing an effect at once, when the motion is ended. This kind of force is of great importance to the dentist. It is a positive force, and when properly applied, it can always be depended upon. It is a powerful agent in spreading the dental arch, obstinate cases yielding readily to the pressure.

If the deformity be only on one side of the arch, it will be necessary to obtain either a point opposite, by uniting three or four teeth with bands, and thus giving a strong support, or to insert a rubber plate and vulcanize the nut into place. When the plate is finished, a groove may be cut or a hole drilled to hold the screw in place. The screw may be called a universal force, as it can be made to force teeth in or out. Where the roots

are in a diagonal position in the jaw, or are in close proximity to their roots, the screw is very effective. We are indebted to Dr. Wm. H Dwinell, of New York, for the introduction of the jack-screw as a powerful and direct force in regulating teeth. The following cuts illustrate those now in the market (Fig. 120). Nos. 1, 2, 3 are the original jack-screws introduced by Dr. Dwinell, and are very efficient when combined with rubber plates. The screw is what is termed in mechanics a right-hand thread with a single nut. The distal end of the screw is made conical that it may be directed either in the plate or band around the tooth to be moved. Holes should never be drilled into sound teeth for this purpose. I have invariably been successful in encircling the tooth or teeth with a band of gold or platinum retained in place by the oxyphosphate of zinc, and for

FIG. 120.

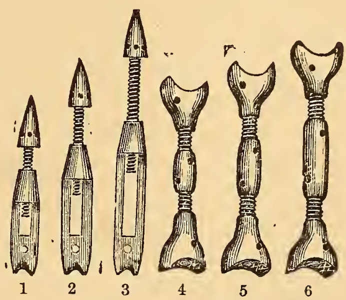
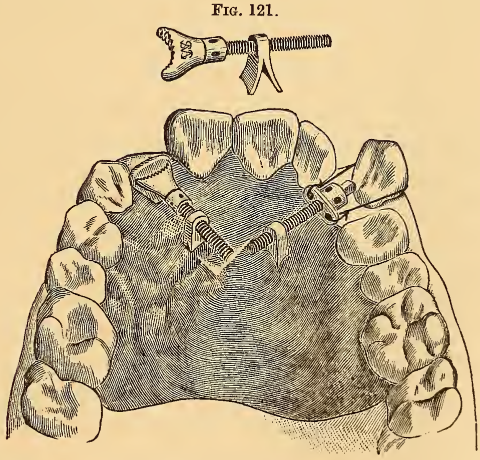


FIG. 121.



the purpose of retaining the band and preventing the accumulation of moisture, have usually drilled a hole through the band to guide the screw.

Nos. 4, 5, 6 show Dr. A. McCullom's invention, and are called

compound jack-screws. They are made with a right and left thread, with nuts to correspond, so that when adjusted they will expand or contract if a lever be inserted in the holes drilled through the centre of the bar and moved in either direction. The length of the bars may differ according to the convenience of the operator.

Fig. 121 represents a very effective jack-screw invented by Drs. Lee and Bennett. It consists of a screw and a split-post nut. The plate must be securely fastened in the mouth; but before its insertion the post should be vulcanized into it. The proximal end of one of the screws has a swivel, which is to be fastened to the tooth in order to push it out into line. The other screw has a cross-head upon its proximal end, with holes drilled through it for the purpose of receiving wire ligatures, which have been passed around the tooth to be brought into line. The screw should always be used in combination with a plate or with bands; otherwise, the teeth and gums are liable to be injured. When the bicuspids or molars stand inside of the arch, and a uniform pressure is required on both sides of the arch, we may prevent the nut from working into the gum by placing around the teeth to be moved platinum bands with projectives soldered to the edge nearest their cervical margins (Fig. 122).

Fig. 122.

ELASTIC FORCE.

Each of the six mechanical forces has its proper place in the art of regulating teeth, and when skillfully applied each is an effective agent. The application of these forces, however, is limited. In looking about for effective powers we find that the force of elasticity as found in India-rubber and the spring of metals combines all that is necessary to render effective either the most rudimentary or the most intricate appliance. The simplicity of the application of this force makes it very desirable in dentistry. Elastic bands cut from French rubber tubing can be universally used, and are applicable to every case of irregularity of the teeth. There is a power in elasticity peculiarly adapted to the correction of irregularities, and which cannot be obtained by any of the forces previously mentioned, viz., a constant, equable pressure, which may be either increased or diminished by the application of larger or smaller bands. This constant pressure produces a rapid absorption of the bone which opposes the restoration of the tooth to its normal position.

When the rubber bands are applied to the teeth, the point of resistance becomes a very important feature. The resistance must equal or exceed that of the body to be moved; otherwise, the weaker will be moved by the stronger force. If a tooth upon one side be irregular, a tooth, or, if necessary, several teeth, at the opposite point must be selected to withstand the pressure of the tooth to be moved. This not only requires a thorough knowledge of the anatomy of the teeth and jaws, but ability to judge the comparative resistance of each tooth. We once tried to draw by the gold band and screw power a right superior cuspid into the space made vacant by the loss of a first bicuspid. The point of resistance was the second bicuspid and the first permanent molar. It was found, after turning the nut two or three days, that the bicuspid and molar had been drawn forward half the space instead of moving the cuspid into the expected position.

When the rubber bands are employed in cases requiring much force, it is generally a good plan to fit a rubber plate to the teeth and jaw, to which arms of rubber or gold are attached in such a manner that the teeth may be drawn in or out, as the case requires. The plate should be fastened by ligatures to fix teeth, and acts as the point of resistance. Rubber bands cut from tubing (or, better, from rubber dam, as suggested by Dr. G. V. Black) are attached to the arms and carried over the teeth to be moved. Fig. 123 is from the model of the teeth of a boy fourteen years of age. The lower jaw occludes outside of the upper. A plate with gold band attachment (Fig. 124) was made to fit the jaw, extending from the first bicuspids around the incisors and cuspids, separated from them by a distance of a quarter of an inch. The plate was secured to the first molars and first bicuspids. Rubber-dam rings were fastened to the band and carried over the incisors and cuspids. The teeth were in a short time brought out in place by the attachment of rubber rings to the gold band and over the teeth. The result is illustrated in Fig. 125. Fig. 126 illustrates a plate made for the purpose of drawing in the protruding central incisors of the upper jaw. A band of gold is adjusted to the labial surfaces of the teeth, to which hooks are soldered and bent over the cutting-edges, to prevent the band slipping up to the gum. An elastic band is fastened to the centre of the plate and attached to the gold between the central incisors. By this means the teeth are readily brought

into their proper positions. When moving teeth or twisting them in their sockets by elastic bands, it is desirable to start the teeth with wedges of wood or rubber, or with the jack-screw, to produce absorption of bone about the roots and make the resisting power less complicated when the bands are finally applied.

Fig. 123.

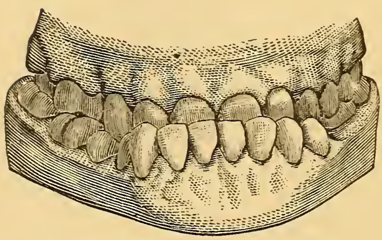


Fig. 125.

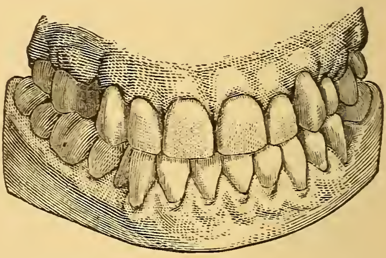


Fig. 127 represents the model of the mouth of a woman twenty-six years of age. The central incisors diverge from the median line, and are also twisted in their sockets. Rubber bands were placed about the teeth to draw them together. The pressure required was so great that two bands, each one-fourth of an inch

Fig. 124.

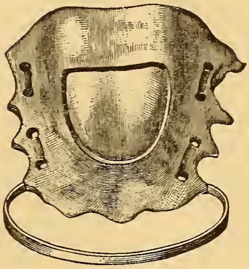
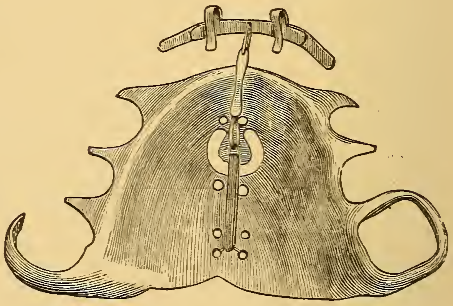


Fig. 126.



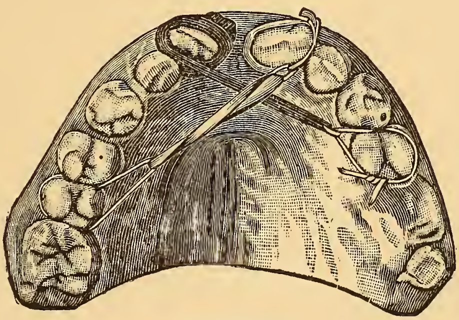
After Kingsley.

wide, with a linen ligature tied with a surgeon's knot on the outside of the bands, were required. Even with this powerful force it took three weeks to bring the teeth together. Having produced absorption of the alveolar process, the teeth were easily rotated in their sockets in the following manner:

A band of platinum was accurately fitted to the crown and soldered. A hook was made by inserting and soldering a pin from an

artificial tooth into a hole drilled in the labio-distal angle of the band; this band was fastened upon the tooth with oxyphosphate of zinc; a band of rubber was then attached at one end to the hook, and at the other to a bicuspid, the tooth being thus rotated into place. Another plan is to dry the tooth, coat it with sandarac varnish, and while moist to wind about it a strip, cut from rubber dam, three-sixteenths of an inch wide and two inches long, with a string tied in its middle, so that the rubber dam doubles upon itself. The band should be wound in the same direction in which the tooth is to be rotated, and the winding should be continued until the end of the rubber reaches the distal edge of the tooth; the string should now be drawn across the mouth and tied to a molar or bicuspid tooth. Either of these arrangements is very effective.

Fig. 127.



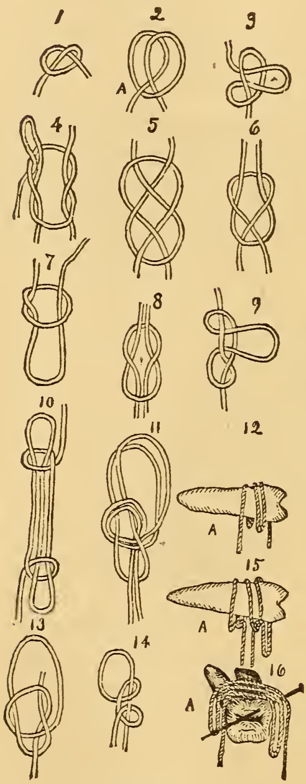
LIGATURES.

Ligatures are cords, strings, or wires for binding the teeth while regulating, for the attachment of other appliances to the teeth, or for holding them securely after they have found their places. Silk, linen or Chinese grass ligatures serve a good purpose, but the ordinary silk twist found in dry-goods stores does the work better than any other ligature. When ligatures are used to regulate, they act upon the teeth to be moved by attaching them to a fixed point, and also by the shrinkage of the fibre when moistened. Care should be taken in tying the knot of a ligature to avoid its working up under the gum. Various knots can be made for this purpose. Fig. 128 shows some good ones. Since the introduction of Dr. Magill's band for regulating teeth, the ligature has become a very useful adjunct for fastening appliances at any point upon the band where a pin has been previously soldered to it.

THE ELASTICITY OF METALS.

The molecules of metals are held together by a force called cohesion. These particles change in their relative positions when the metal is acted upon by an external force. If this force be removed before these changes exceed a certain limit, the particles return to their previous positions. This power of returning to original form is called elasticity. This elasticity of metals may be utilized in regulating teeth with powerful results, which are only limited by the amount of spring which a metal possesses. Metals are classified as perfectly elastic and inelastic, which terms imply that there are many degrees of elasticity between the two extremes. It is now claimed that a metal cannot be perfectly elastic; that is, it cannot go back exactly to its previous form. It is also claimed that every body is elastic in a degree. Pure gold itself belongs to the inelastics; when alloyed with other metals, *e. g.*, platinum, it is a perfectly elastic metal. Some members of the dental profession have utilized this force for regulating with great success.

Fig. 128.



After Farrar.

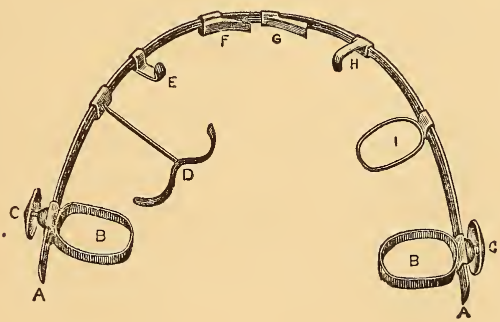
CHAPTER IV.

CONSIDERATION OF DIFFERENT METHODS.

THE PATRICK METHOD.

The system of regulating devised by Dr. J. R. Patrick, of Belleville, Ill, is unlike any of its predecessors. It is based upon the elasticity or spring of a bow-spring wire of platinized gold, which is anchored by suitable bands to teeth selected for this purpose. The wire is half round and of a standard size; the bands for anchorage are attached to suitable slides, fitting the wire accurately, so that they

Fig. 129.



can be at once adjusted to the teeth selected. The force of the bow-spring wire is applied to the teeth which it is desired to move by means of wedges, hooks, T-bars and catches, of shapes and sizes as desired, which are attached to similar slides, all fitting the bow-spring wire, so that any desired number or forms of appliances can be readily adjusted at the same time.

Figure 129 represents the bar or wire, which is bent so as to conform to the buccal surfaces of the teeth; and the different attachments are also shown. In use, the anchor bands are properly adjusted and retained in position by set-screws passing through them, and provided with a head or button for turning them, as shown. The wire rests upon the buccal surfaces of the molars to which it is

attached, and the hooks, wedges or other appliances are brought to the positions desired.

Any tendency of the anchor bands to change their position upon the teeth may be obviated by lining them before adjustment with thin oxyphosphate of zinc. If the bar incline to slip upward toward the gingival margin, this may be obviated by an attachment in the shape of a small hook resting upon one of the teeth.

The apparatus acts as a lever, the power being the elasticity of the bow-string, the fulcrum the teeth used for anchorage, and the resistance the tooth or teeth to be moved. Rubber bands may also be used as auxiliaries.

This appliance is ingenious and possesses many advantages. It is claimed by the inventor that any form of irregularity can be successfully treated with it. Only one band is needed, and no impression of the mouth is required; being composed entirely of incorruptible metal, it is easily and thoroughly cleansed, and without removal from the mouth. It can also be adjusted or tightened at any time without removal. It can be applied to either jaw with equal facility.

The principal objection urged against this appliance is that the teeth used as fulcrums or attachments are sometimes not sufficiently firm to resist the pressure they are required to sustain, and in that case will move before the tooth which is being operated upon. This could probably be obviated by attaching to more teeth.

The construction must, of necessity, be accurate, and if made by the dentist, requires great nicety of workmanship. But all difficulties of this nature are banished by the fact that it can be obtained at the dental depots.

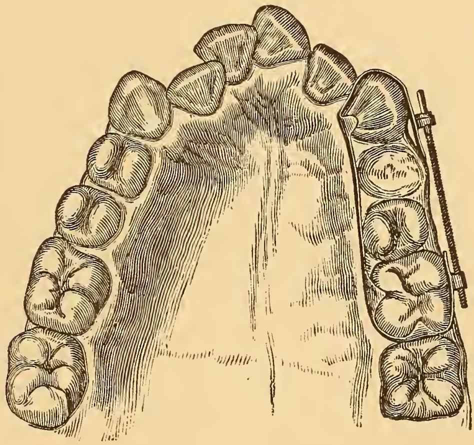
THE FARRAR METHOD.

Of the distinctive systems of apparatus for regulating the teeth, those devised by Dr. J. N. Farrar, of New York, were among the first to be presented to the profession. They were introduced by him about 1873. The principle upon which they operate is peculiar to the system, which is called by him "The Positive." In all (or most) methods employed previously, the endeavor was to bring to bear upon the tooth or teeth to be moved a force that should be, so far as possible, *continuous*. Rubber bands, springs, etc., are examples of this continuous force, which it is the endeavor to con-

tinue, in greater or less degree, from the beginning to the end of the operation.

Dr. Farrar's system is peculiar in this, that he uses, when he can, the *screw* for power, which he considers to be the only force capable of being accurately applied with a definite and positive result. His theory is that a tooth should be moved a certain distance, as far as it is safe or proper, at *one* operation, and then retained immovable in that position until another operation. By this means he claims that the tissues in front of the advancing tooth are compressed, and kept compressed, to such a degree that absorption takes place readily and without inflammation, thus making place

FIG. 130.



for the tooth being moved, while, at the same time, a deposition of tissue takes place *behind* the tooth, tending to retain it in its new position. This, then, is the principle of the Farrar method: a positive movement to a known and definite extent, the tooth being retained by the appliance in the new position, and a period of perfect rest allowed to intervene before more force is applied.

The apparatus by which the results are accomplished is constructed of 18-carat gold. An illustration of one appliance is shown in Fig. 130.

In most of his appliances is a screw, upon which the threads are cut—one hundred and forty to an inch. The end of the screw is fitted to be turned with a watch key (Fig. 131), one-half a turn

twice a day will move the tooth $\frac{1}{140}$ of an inch a day, which rate of progress Dr. Farrar finds, by experiment, to be about the maximum rapidity consistent with safety; and he claims that this will produce only a slight uneasiness or sense of tightness, and no pain. He also claims that patients may be easily instructed to

FIG. 131.

turn the screw themselves, and to regulate the pressure by the sense of tightness, thus saving many visits to the office and the time of the operator.

THE BYRNES METHOD.

Dr. B. S. Byrnes, of Memphis, practices a method of regulating which is worthy of notice.* He uses thin gold bands, 20 or 22 carats fine, the motive power being the spring or elastic force of the bands. No plates are used, the anchorage being obtained upon such of the teeth as are suitable. "The fixed points having been determined, the teeth to be regulated are connected to them by means of a thin gold band. This is so manipulated as to form a spring or series of springs, so adjusted as to bear most powerfully on the misplaced tooth or teeth. For instance, in the case of a misplaced incisor, to be drawn inward, a continuous band embracing the first molars on each side is fitted around the outside of the arch. With a dull-pointed instrument like a burnisher, the ribbon is then pressed into the interstices of the teeth over which it passes, thus forming it into a series of small springs. The incisor, being the most prominent point, will naturally be most affected by the pressure exerted by the springs, and in a short time it will be found to have moved away from the band, so that it is no longer affected by the tension of the springs. The apparatus is then removed, the ribbon is annealed, straightened, and a small piece cut out of it; the ends are soldered and it is replaced, and the band formed into a spring, as before."

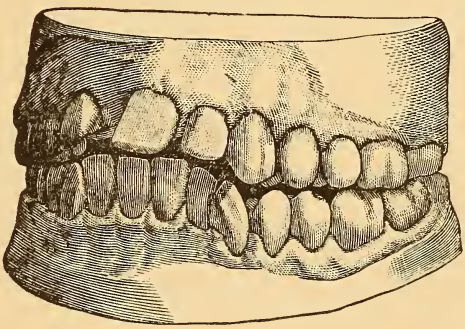
This method is stated to be equally applicable to both simple and

* *Dental Cosmos,* May, 1886.

complex conditions. Sometimes the spring of the band may be advantageously supplemented by other aids, as the insertion of a rubber wedge at particular points. The fixture in all cases should be perfectly tight-fitting on the teeth. It may be applied gradually, so that the teeth yield, and the appliance will then more readily go into its place. When the rubber wedge is to be used, it should be inserted behind the band opposite to one of the interstices; then being stretched, it can be worked to the desired spot, when the ends should be clipped off.

Fig. 132 illustrates a case treated and described by Dr. Byrnes. The patient was a young lady of eighteen years, who had lost the

Fig. 132.



right superior central at the age of eleven. A vulcanite plate had been worn for three and a half years. The remaining upper anterior teeth had been forced outward until they stood at an angle of forty-five degrees when first seen. The lower incisors stood inside the arch, and the chin was consequently wrinkled and upturned. The lips wore a constant pout, the mouth being what is termed peaked, the molars being the only teeth that occluded properly.

In treating this case it was the object,—1st, to correct the "peakedness" by producing a broader and more oval arch; 2d, the reduction of the projecting teeth; 3d, the improvement of the articulation; and 4th, the closure of the space caused by the loss of the central. The last was undertaken first. The heavy band (Fig. 133) was used to force the cutting edges of the right central and left lateral together. A very thin narrow gold band was then fitted to embrace the necks of these teeth, and a wedge of wood was in-

serted on the side next the cutting edges, causing the teeth to move vertically toward each other. Another band (Fig. 134) was then constructed to move the incisors backward, and was placed in position without removing the first. It embraced the cuspids and bicuspids on each side; the connecting band was pressed into the interstices, and rubber wedges inserted. The effect of this was not

Fig. 133.

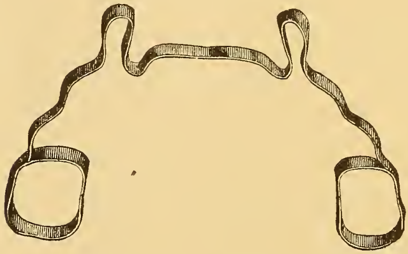
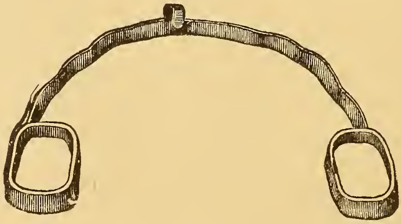


Fig. 134.

only to cause backward pressure upon the incisors, but an outward pressure on the cuspids and bicuspids. At the end of three weeks the work was practically accomplished, and the fixture was replaced by that shown in Fig. 135, which completed the movement of the teeth, and acted as a retaining piece. The small hook counteracted the tendency to slip up toward the gum.

Fig. 135.



The regulation of the lower teeth was begun soon after that of the upper jaw was completed, and was carried through in about three weeks. A band, shown in Fig. 136, was used, clasping the first molars, passing around the bicuspids and behind the incisors. A wooden wedge was placed between the incisors and the band, and springs formed by pressing the latter into the interstices between the cuspids and bicuspids. In two weeks this apparatus was re-

placed by that shown in Fig. 137. A little block of rubber under each of the rings, which rested upon the cuspids, completed the work in a week. The rings being pressed back to preserve the

Fig. 136.

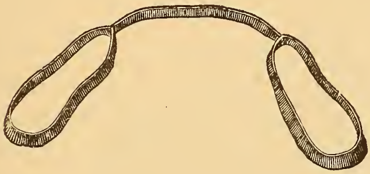


Fig. 137.

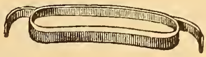


Fig. 138.

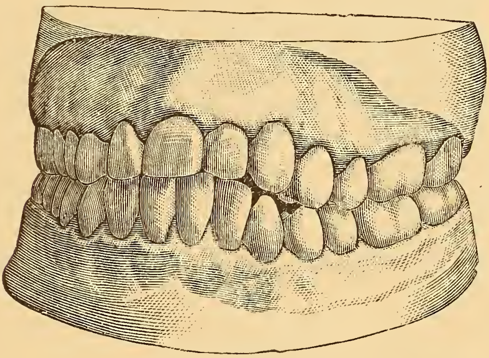


Fig. 139.

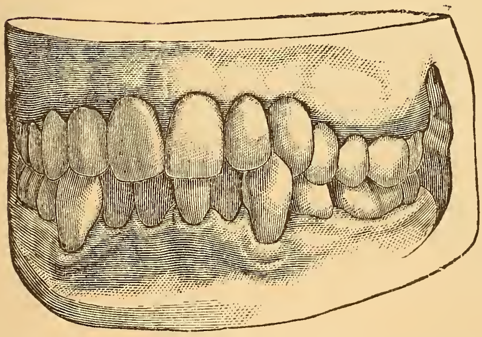
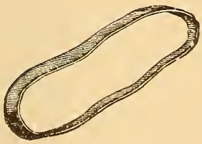


Fig. 140.

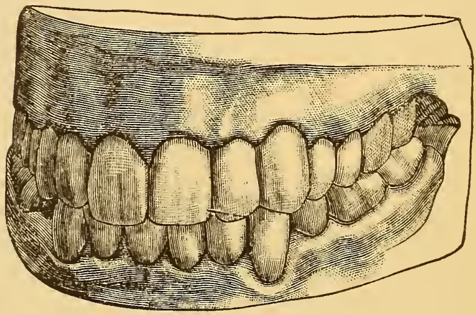


ground already gained, the piece was worn as a retaining plate. The final result is shown in Fig. 138.

Fig. 139 illustrates the teeth of a lady aged twenty-eight. The lower cuspids closed in front of the upper; the dentes sapientes were

erupting into a crowded arch, and pushing the lower cuspids still further forward. The first bicuspids were extracted to make room, and the cuspids were moved backward by means of a band, shown in Fig. 140, which embraced the first molar and cuspid. The

Fig. 141.



molars were capped to prevent occlusion, but the age of the patient preventing rapid movement, the bands were cut and tightened only twice a week. In ten weeks the work was completed—Fig. 141 showing the appearance at the conclusion of the treatment.

Fig. 142.

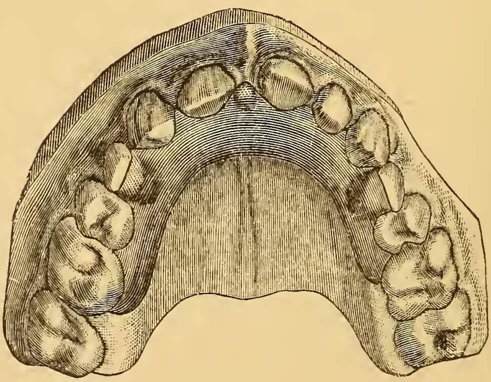
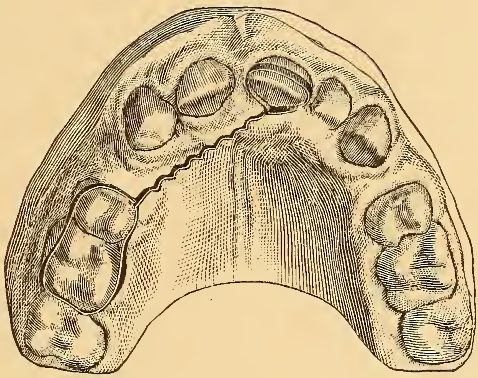


Fig. 142 shows the upper jaw of a lady aged twenty-two, who fell at the age of ten years, striking the superior teeth in such a way as to knock out the right lateral and dislocate the other incisors, the left central remaining at an angle of thirty-five degrees after its attachment was again renewed. The incisors were separated

from each other, and the deformity was much more marked than shown by the cut.

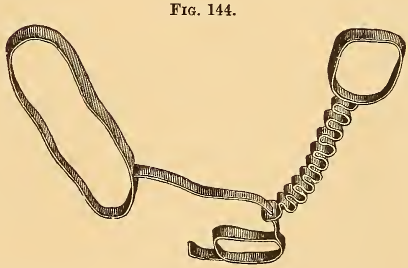
Fig. 143 shows the appliance in position used by Dr. Byrnes in this case, by which the regulation was completed in eight

Fig. 143.



sittings. The connecting band was crimped as shown, thus converting it into a series of springs. Fig. 144 was used in a case in which the right central overlapped the lateral. The

Fig. 144.



springs were adjusted so as to turn the tooth, the work being accomplished in four days, after which it was retained by a simple band, with wings resting on the left central and under the right lateral.

THE HEADRIDGE-COFFIN'S METHOD OF PRACTICE.

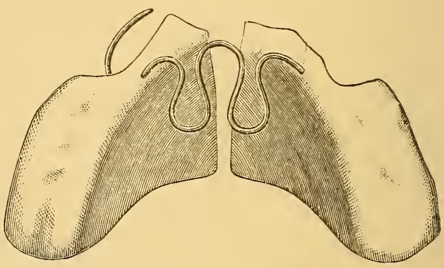
Dr. Walter H. Coffin, of England, read a paper before Section XII. of the International Medical Congress, held at London, in August, 1881, upon "A Generalized Treatment of Irregularities"

Upon that occasion he described a system of cleft-plate devices. The principle upon which this system of regulating is based is different from most others. It was not new nor entirely their own. Since it became known in this country it has come into considerable use, and is popularly known as the "Split Plate" Method.

The principle upon which this method acts is by the construction and adaptation of a vulcanite plate, not only covering the hard palate, but capping the posterior teeth ; the plate, after vulcanizing and finishing, is to be split into halves. These halves are connected by a piece of wire bent into the shape of the letter W (Fig. 145), having the ends flattened and imbedded in the vulcanite plate. This wire, or spring, being suitably adapted to the cast, and bent with the proper shape while cold, is pressed into the wax

FIG. 145.

FIG. 146.



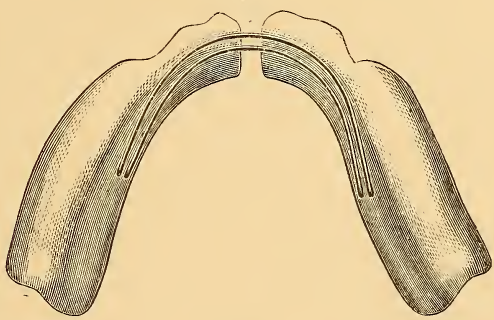
model upon the cast until the proper position is secured. To prevent its displacement while packing, bits of binding-wire may be twisted around it at various points, which will hold firmly in the plaster. A piece of heavy tin-foil covering the wax model on the lingual surface will bring out the rubber with a polished surface under the wire. The piece, having been vulcanized, is split lengthwise with a fine saw (Fig. 146). The plate is now introduced and properly fitted. To secure acccurate adaptation to the teeth, a perfect impression and a perfect model are necessary. Dr. Coffin recommends gutta-percha or balleta gum (modeling compound).

The plate, being properly adjusted in the mouth, is worn without any tension for a day or two—until the patient has become accustomed to its presence. The two halves are then separated by being stretched apart, by which means the piano-wire is converted into a spring of great power and constant tension. It is claimed that any desired direction may be given to the force, and the pressure thus

brought to bear where it is most needed, but by many dentists this is not easy.

The primary effect of this arrangement is of course, to expand the arch laterally, thus affording room for the rotation or removal of the irregular teeth. In a large majority of cases such an expansion is either absolutely essential or highly desirable, and by this appliance this is claimed to be easy to do. The inventors even claim that, paradoxical though it may seem, it is less painful and troublesome to secure in this way ample spaces between all the front teeth at once than to wedge two of them apart in the ordinary way, with the advantage of easily maintaining their separation.

Fig. 147.



This appliance, as will be readily seen, is designed for an altered shape or outline of the dental arch; where this is not needed the power of the spring, or of a suitable spring properly inserted, may be brought to bear upon any tooth which it is desired to operate upon, so as to produce rotation or movement in any direction. In this case the plate is not split, but wire is anchored into it in a suitable position, its end protruding to bear upon the tooth it is desired to move. Wires can be inserted so as to operate on one or two teeth at the same time. (Fig. 146.)

The same principle may also be applied to the regulation of teeth in the lower jaw. In this case the plate (Fig. 147) is made in a horseshoe form, and the wires lie along its lingual aspect in a simple U-shape or semicircle, the plate being divided at the median line.

By stretching the spring more and more as the case progresses, an expansion to a very considerable extent may be effected, and

so easily that caution must be observed not to exceed the intended results.

PIANO-WIRE.

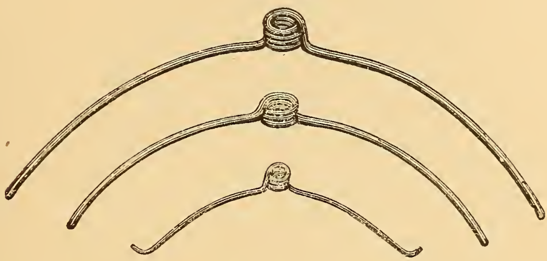
Piano-wire is manufactured in Germany, England and America. It is made of the best steel, drawn through a draw-plate to the required size. The polish and temper are given during this process. The wire must be extremely pliable and strong to endure the tension which it undergoes during the tuning process of a piano. It must also be perfect in construction, as any flaw in the wire would cause it to snap when being manipulated. It has advantages over any other wire for dental purposes. It is inexpensive, has greater elasticity than other wires, and can be more easily adapted to a variety of cases. It can be bent in any way necessary to obtain the greatest amount of force, and can be applied to any place in the mouth, on account of its small size and weight. Sizes 18, 19, 20 are better suited to the majority of irregularities, the strength of the wire to perform a given operation depending upon the age and constitution of the individual and the character of the irregularity. In youth or in delicate organizations, No. 20 is the size best adapted to regulate; the sizes should decrease to No. 17 as the years advance, or as the stubbornness of the irregularity demands. The selection of the wire, and adapting it to each special case so as to obtain the best results and avoid producing inflammation, will require the nicest discrimination.

THE AUTHOR'S METHOD—THE COIL SPRING.

In order to obtain the best results, the elasticity of the wire was increased by coiling it from one to three times around a mandril. The author has placed his coil springs at the dental depots for the benefit of those who cannot take the time to make their own springs. The mandril is driven into the bench, and with the right hand the wire is coiled about it as many times as required, the short end being held firmly by the left hand. The coil ends directly at the starting-point, and gives thereby the greatest elasticity and length of arms. When necessary, the long end of the wire can be bent with square-nose pliers to make it on the same plane with the other arm. Fig. 148 shows the coil spring.

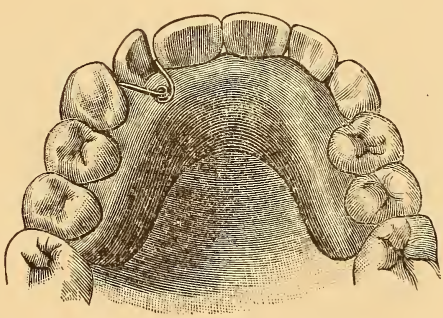
The coil of the spring works on the same principle as the mainspring of an American watch, which between two points measures a uniform period of time. The extremities of the arms of the spring travel over a given space with like uniformity, which gives a mild, uniform pressure to the jaws and teeth. The arms may be bent or cut at any length to suit the case in hand. They may be used in connection with a rubber plate, or with bands of gold or platinum fastened to the teeth with oxyphosphate of zinc.

Fig. 148.



With holes properly drilled in the plate or bands, and the arms fitted into them, the spring will stay in position. When the spring is used without a plate, it will be well to fasten the wire in some of the teeth to prevent its being swallowed.

Fig. 149.

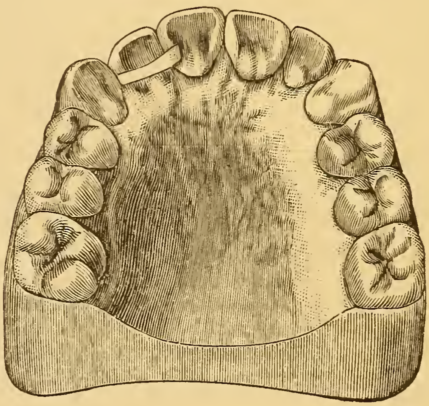


The following histories will illustrate some of the cases in practice:

The following models of the mouth of a girl sixteen years of age were presented to the author, who assisted, by Dr. J. F. Austin, of Chicago. The right cuspid had encroached upon the lateral incisor

to such an extent as to twist and force it out of position, leaving only about one-half of the space necessary to rotate the tooth into place. A plate was made to fit the mouth and teeth, and a coil-spring inserted, with arms meeting the cuspid and central incisor. The spring was secured to the plate by a pin driven into the plate (Fig. 149). By the lateral pressure of the spring the teeth were

Fig. 150.



pushed apart, making space for the teeth to be rotated into place. Fig. 150 shows the tooth secured in position by the Magill retainer.

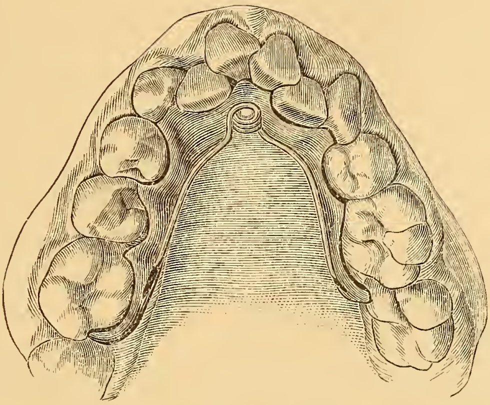
SPREADING THE DENTAL ARCH.

On an exact plaster model of the case to be regulated a thin, narrow vulcanite plate is formed, with a short vertical post fixed, either before vulcanizing or afterward by drilling centrally in the plate on the median line. Grooves or slots are, with a wheel bur, cut in the sides of the plate to receive the ends of the spring and prevent its displacement after the coil has been placed on the post. Fig. 151 represents such an appliance in position on a plaster cast of the inferior maxilla of a boy aged twelve years, and it will thus be seen that the movements of the tongue would not be, as in practice they were not, seriously restricted. The tension of the spring is changed by simply bending outward or inward its arms, and in many cases the apparatus may be inserted or removed with great facility, and its action be so continued and controlled that the required expansion may be obtained and maintained by the use of

but one plate. This plate, with spring attached, was removed by the boy twice a day, and the teeth and plate cleaned.

In spreading the dental arch the majority of cases require the greatest pressure on the anterior teeth, and an appliance that can

Fig. 151.



be placed inside the arch will exert the greatest influence. The force is equally distributed on both sides of the mouth, and if constant the work will be accomplished rapidly, without inconvenience to the patient. Such an appliance is here illustrated (Fig. 152). It

Fig. 152.

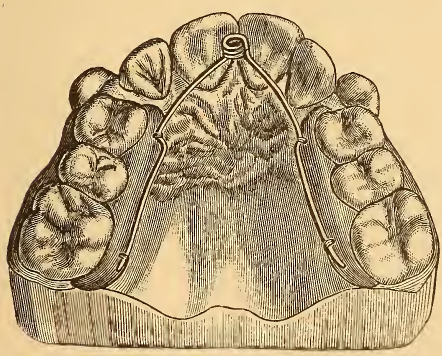
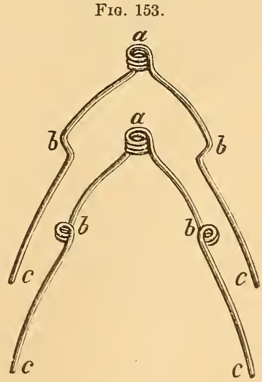


Fig. 153.



is used in the mouth of a young girl fourteen years of age. A plate is made to fit the teeth and alveolar process, and cut away so that the anterior parts extend far enough forward to inclose the teeth to be moved. A piece of wire is bent into either of the forms

shown in Fig. 153, wherein *a* is the coil and fixed point, and *b b* movable arms extending from *a*, and also fixed points, *c c*, movable arms extending from *b b*.

Grooves are cut into the anterior and posterior parts of the plate to correspond with and receive the points *b b* and *c c*. Holes are drilled at these points, and the wires tied to the rubber plates. In order that the anterior teeth may be moved with the greatest force, the arms are so adjusted that the greatest pressure is exerted on the anterior parts of the plates. This appliance is readily removed for cleansing, and returned to place by the patient.

Another appliance for spreading the dental arch that has been successfully used by the author is illustrated in Fig. 154; it consists

Fig. 154.

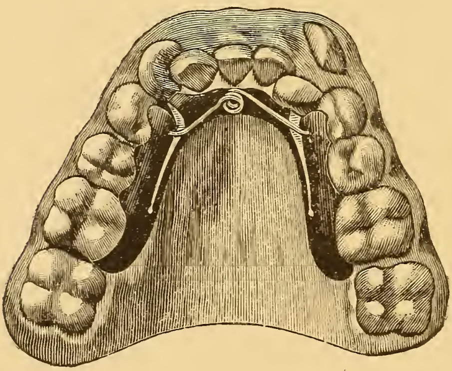
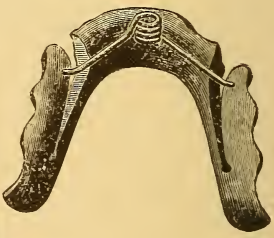


Fig. 155.



of a rubber plate made to fit the teeth and jaw. The plate is then sawed lengthwise—commencing at a point anterior to the teeth to be moved; a hole is drilled at the point where the slot stops, to prevent the arms breaking. At the extreme end holes are drilled to receive the spring. To adjust the plate press the arms together and drop the plate into place. Fig. 155 shows the plate out of the mouth. This can be removed and inserted *ad libitum* by the patient.

A form of dental irregularity very difficult to correct is found when the cuspids are situated near or in contact with the centrals, while the laterals stand inside of the arch, and when the jaws are closed pass behind the central incisors. If these laterals are in near relations to each other, it is by ordinary means well-nigh

impossible to interact upon them with sufficient pressure to force them apart; the space being quite too short to admit a jack-screw.

Fig. 156 represents such a condition. The cut is made from the cast of a case in practice, the patient being a young woman eighteen years of age, who came under my care in 1883. The superior laterals were then only one fourth of an inch apart, and closed behind the inferior incisors. There were but small spaces between the superior centrals and cuspids.

Thin platinum collars were made to fit the laterals, on which, after drilling a hole in the side of each collar, they were firmly fixed with oxyphosphate of zinc. A spring was bent into the form shown by Fig. 157, the ends of the arms being turned at a sharp angle and cut short, as seen in the figure.

The spring was then put in place, the arm ends entering the

Fig. 156.

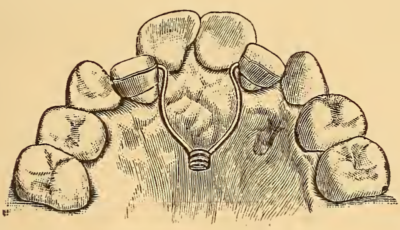


Fig. 157.

holes in the collars, and the curved arms found to be so closely conformed to the surface of the gums and palatine parts that the fixture was no obstruction to occlusion, and yet could be easily sprung out of position for cleansing purposes or for increasing the expansive power of the spring, by simply widening the lateral spread of the arms. Fig. 156 shows the progress made in four weeks' treatment. When the laterals had been moved past the sides of the centrals, they were by other means forced outward into line.

REGULATING INDIVIDUAL TEETH.

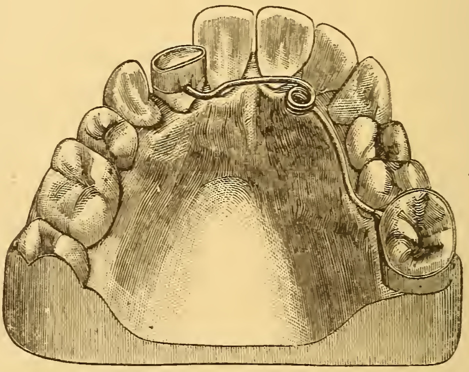
To force out central and lateral incisors, I have found the following methods useful: Around the tooth to be moved, and around the molars, as nearly opposite the direction the incisor is to travel as possible, fit platinum collars. Solder cups upon the collars directly opposite and in line. Make a spring of piano-wire (Fig.

158), and spring it into the cups soldered upon the collars. In Fig. 159 the appliance is seen in place.

Another method is to make a plate to fit the teeth, thickening it nearly to the cutting edge of the tooth to be moved, and drilling a

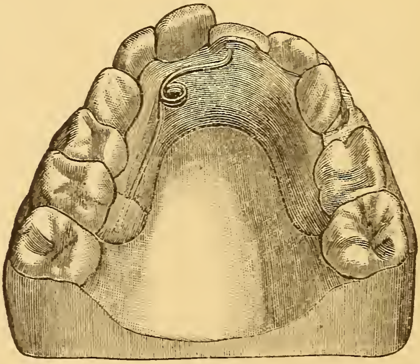
Fig. 158.

Fig. 159.



hole through the thickened part. Directly opposite, at some convenient point on the back part of the plate, drill another hole just deep enough to hold the spring in place (Fig. 160). If the hole in the thickened part be drilled in the proper place, the end of the

Fig. 160.



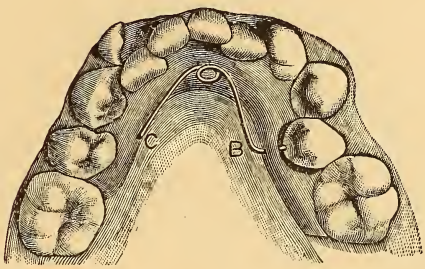
spring will hit the tooth midway between its cutting-edge and the margin of the gum. The spring is very effective. The pressure is constant, and the spring is readily removed for adjustment or for any other purpose.

We frequently find a single tooth situated inside the dental arch, and have trouble in contriving an apparatus suited to the correction of such an irregularity.

The illustrations represent some simple appliances that have been thoroughly tested and found satisfactory, in that they do the work effectively, are easy of adjustment and removal, and may be readily cleansed.

Fig. 161 illustrates a second inferior bicuspid of the right side, having a lingual presentation equal to one-half the thickness of the

Fig. 161.



tooth inside of its normal position. The cut also shows teeth in other malpositions; but for our present purpose these are not considered.

For this case a thin, narrow, close-fitting vulcanite plate was made, and a hole was drilled through the middle of the plate opposite the centre of the tooth to be moved. In the other side another hole was drilled, but not quite through the plate. A suitable spring (Fig. 162) was then made of piano wire, having a single

Fig. 162.

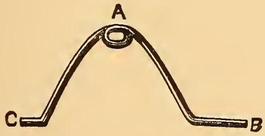


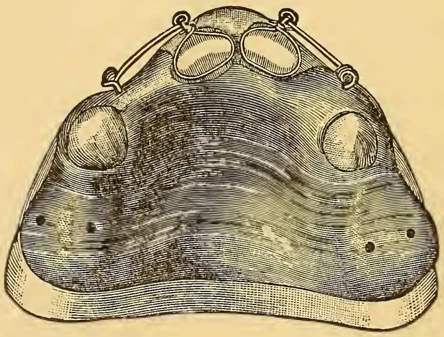
Fig. 163.

coil, *A*, and the ends of its arms bent at about a right angle. One of these ends, *C*, was cut short to enter the corresponding hole in the plate, and the other end, *B*, left long enough to go through the plate and impinge on the lingual surface of the bicuspid, leaving a full eighth of an inch between that arm of the spring and the plate, as is clearly shown by Fig. 161. Fig. 163 shows both arms,

B B, of the same length, to pass through the plate and impinge on the lingual surfaces of teeth upon opposite sides.

Fig. 164 shows an appliance for pulling out the central incisors. A plate is made to fit the jaw and teeth, and into it were vulcanized two of the Talbot springs at the lateral incisor region. The wire arms were turned into loops at the extremities to secure a

Fig. 164.



ligature. When the plate was adjusted, the arms were bent horizontally, and brought in close proximity to the labial surfaces of the centrals incisors and securely tied. By this means constant pressure was applied, and the teeth were carried outside of the inferior incisors.

CHAPTER V.

TREATMENT OF SPECIAL FORMS OF IRREGULARITIES.

ROTATING TEETH IN THEIR SOCKETS.

The Farrar Method.

Dr. Farrar has devised for this purpose several modifications of devices belonging to his "positive system," one of which is illustrated in the following cuts:.

Fig. 165.

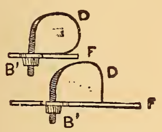


Fig. 166.

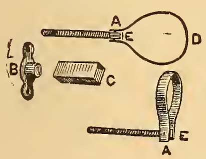
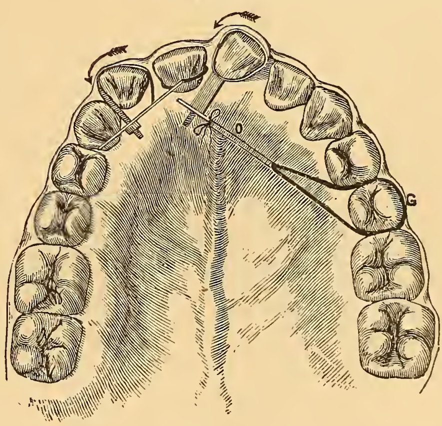


Fig. 167.



Figs. 165 and 166 represent screw-wrenches made of 18-carat gold, with the exception of the screw in Fig. 166, which may be made of brass or steel, as desired. If the form represented in Fig. 165 be used, it is adjusted on the tooth, and the thin gold of which the band is composed is made to hug it by tightening the nut, *B*, and the end of the bar, *F*, resting firmly against the adjacent tooth; tightening the nut once or twice a day causes the tooth to rotate. If the box-wrench (Fig. 166) be used, the arm acts as a lever, to which is attached a band of rubber, and ligature attached to a firm tooth, as shown in Fig. 167. Or, both forms may be used, as in Fig. 168, the power being obtained by a screw rotating in a swivel, *K*, attached to a distant tooth.

Figs. 169 and 170 show another form of apparatus, so simple and so plainly shown by the cuts as to require little description. The

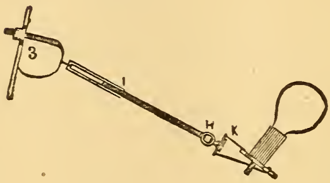


Fig. 168.

Fig. 171.

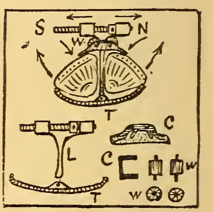


Fig. 172.

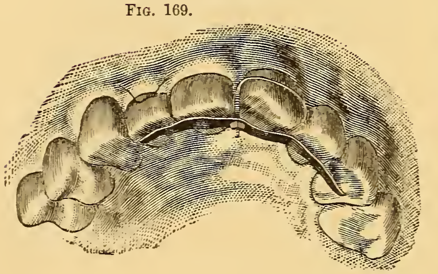


Fig. 169.

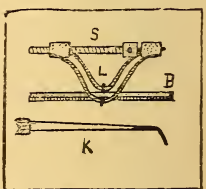


Fig. 173.

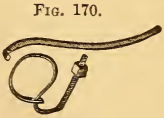


Fig. 170.

strip of plate resting on the palatal surfaces of the adjoining teeth serves as a fulcrum, and the tooth operated on is rapidly drawn

into line and rotated. Fig. 169 represents an upper case treated by Dr. Farrar, and, as he states, the patient, about thirty years of age, manipulated the apparatus himself, reporting only once during the week that the operation was in progress.

Fig. 171 illustrates a right-angle key or wrench, with bevel pinions similar to the right-angle engine attachments which Dr. Farrar uses for turning nuts in localities such as that shown in Fig. 169, or in other localities where it is difficult to use the ordinary wrenches.

Dr. Farrar's "triplex system" is also adapted to the treatment of either of these varieties of irregularity, as illustrated in Fig. 172. "The bearings of the bands upon the different points of the teeth and the directions of their movement are indicated by the arrows, while the details of construction are shown in the figure, and the device is made as follows: A stiff strip of plate, *T*, is bent on a form to loosely fit the necks of the teeth at certain points under the free margin of the gums, and prevent the plate from slipping from the teeth; and the ends of the plate are so shaped as to bear firmly on the distal corners of both teeth. These bearings may be changed by properly bending the ends of the plate as the operation advances. The bridge, *C*, carries two rollers, *W W*, between which the thin ribbon loop, *L*, passes, and is caught by its fold on a wire attachment to the middle of bar, *T*, as shown in position on the tooth. The screw, *S*, is swiveled in the *N* end of the metallic ribbon loop, and screws into the threaded end, with the effect of separating the ends of the loop, which thus moves the bridge toward the bar and rotates both incisors.

"Other modifications of this device may be adapted to different presentations of this class of cases, the main thing to be kept in view being the points of bearing of the bridge, *C*, and the bar, *T*; for while the apparatus will work well when the teeth have small necks, it is difficult of retention upon tapering teeth.

"In some cases a firmer hold on the teeth may be obtained by a pair of narrow loops, the folds of which pass on either side of the bar, around the ends of a pin passing through and projecting from the middle of the bar, as shown in Fig. 173 The bar thus made and connected is easily detached for the purpose of bending its arms to obtain rotative bearings. A key for turning the screw may be readily made from an excavator, shaped as shown at *K*, Fig. 173."

THE GUILFORD METHOD.

Dr. S. H. Guilford has devised a little fixture for correcting malpositions of the central incisors, shown in Figs. 174 and 175. According to his description, it is constructed as follows: A piece of gold backing one-eighth of an inch wide and sufficiently long to extend along and a trifle beyond the palatal surfaces of the centrals, is bent to conform as closely as possible to their lingual surfaces, and forward so as to slightly clasp the disto-palatal angles, as shown at Fig. 176. To this are soldered two strips cut from

Fig. 174.

Fig. 175.

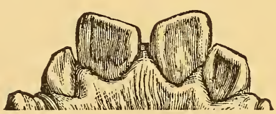


Fig. 176.

plate-scrap, a little narrower than the first piece, and bent in the form of *b* and *c* (Fig. 176), respectively, which are sufficiently long to extend slightly over the anterior and posterior surfaces of the teeth. After being properly shaped to fit the model, their backs are soldered together and to the part, as shown in Fig. 177. The part *b c*, which passes between the teeth, is reduced sufficiently with a file, or the teeth may be separated by wedging, to allow the insertion of the fixture. The labial part should rest against the teeth just at or slightly above the most prominent part of the convexity, while the lingual portion should be near the gum, but not quite touching it. The slightly-curved ends will catch just above the little nodule usually found on the disto-palatal angle near the gum. Thus secured, it cannot be easily displaced. Bend the long palatal arms slightly toward the short labial ones daily, and spring them into position on the teeth. The elasticity of the gold, stiffened by the solder, will do the work. "By this means," says Dr. Guilford, "the use of all rubber or silk ligatures, so irritating to the gum and so painful in application, is dispensed with." Fig. 174 illustrates a case treated by Dr. Guilford with this appliance, the cure being complete after a treatment of ten days, the patient having been seen every day. The general form of the appliance is also equally useful in correcting teeth in the

Fig. 177.

reverse position, shown in Fig. 175. In this case the construction is reversed, so that the long arm or band may rest on the labial and the short one on the palatal surfaces, and so bent as to throw the distal angles inward.

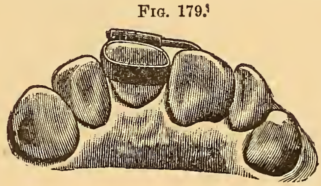
The same appliance, slightly modified, he says, is also useful for rotating a single incisor where its mate is already in position. In this case the end of the appliance is fitted nicely to the tooth in position, while the other half is so shaped as to give the desired pressure on the tooth to be rotated.

THE AUTHOR'S METHODS.

In June, 1884, the following treatment was begun by me for rotating the central incisor of a patient. A platinum band was made to fit the tooth, and a tube of the same material was soldered lengthwise with the band (Fig. 178). The band was secured to the tooth with the oxyphosphate of zinc, a piece of piano-wire being passed into the tube and allowed to extend to the left central incisor (Fig. 179). The wire was bent every day, and the tooth thus

Fig. 178.

Fig. 179.



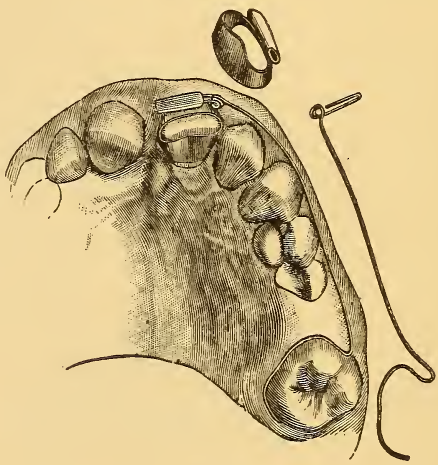
rotated into place. When practicable, we should solder a flat tube to the band for the purpose of holding a flat lever, which would prevent the rotation of the arms.

For rotating a tooth the most efficient contrivance is the combined lever and collar, fitting and fixed upon the tooth by cement. (Fig. 180.) The soldering of a flattened tube across the face of the collar affords a means for the insertion and removal of the lever at will.

I prefer a lever made of a piece of thin piano-wire, No. 27, U. S. gauge, one end of which is folded upon itself for about a quarter of an inch, and the wire then coiled once or twice close to the folded end (see illustration). The other end is bent to hook around a molar or other posterior tooth. The illustration shows such a tubed collar and wire lever separately, and also in place on the tooth which is to be rotated. It is obvious that the lever can be removed

or applied without detaching the cemented collar. In operation, the compound lever effects a complex movement of the tooth which is being rotated by the lever as a whole, and is at the same time thrown outward by the hinge-like action of the short lever turning on the coil as on an axis—the result being the proper alignment of the tooth, *if* the spring of the coil and the elasticity of the lever are so judiciously combined as to be adapted to the requirements of the case in hand.

Fig. 180.



The other central incisor could likewise be simultaneously rotated, and, after both teeth had been brought into position, a folded wire bar through both tubes would retain them in place so long as might be deemed desirable.

MOVING CROWNS AND ROOTS.

In most of the operations for regulating teeth, the apices of the roots are in a position either normal or approximating to it in such a degree as not to require moving. But in some cases it becomes necessary to move the whole root. For this purpose, although the power may be the same, yet it must be made to act in a different manner.

In ordinary moving of teeth, the power is at one end, the resistance at the other, while the fulcrum is in the middle of the tooth to

be removed. Dr. Farrar illustrates in Fig. 181, where *P* is the power, *F* the fulcrum, and *S* the resistance. The power being continued, the teeth are drawn in the direction indicated by the arrows, *U*. The first effect of this movement, so far as the roots are concerned, will be to cause them to impinge against the septum *B*, at the point *F*, and also against the socket wall at the point *S*. They

Fig. 181.

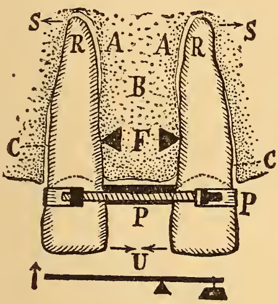
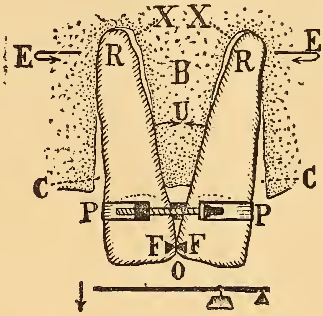


Fig. 182.



will also separate from the sockets at the points *A* and *C*, as indicated by the arrows. If the force be continued in this direction until the points touch, as in Fig. 182, the lever is changed into one of another variety, in which the power is applied between the ful-

Fig. 183.

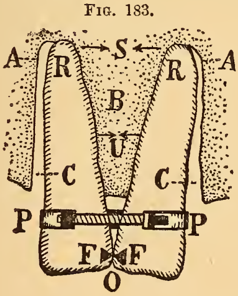
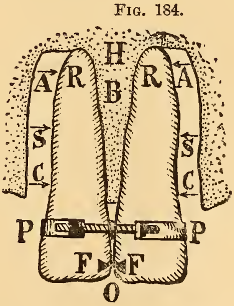


Fig. 184.



crum and the resistance (*X*, Fig. 182). Thus the same power from the same apparatus acts in exactly the opposite manner, causing the roots to approach each other throughout their length (the fulcrum being at *O*, Fig. 183), and leave the socket walls in the same manner. Fig. 184 shows the completion of the operation.

The appliance used by Dr. Farrar in one such operation is shown

in Figs. 185 and 186. "It is made up of two parts—a clamp band to draw the teeth together, and a lock portion to hold stationary the cutting edges of the teeth; but while the teeth are being drawn together, only the band portion need be used. On each extremity of a band made of light and strong rolled wire is soldered a nut, one of them being a screw nut. Through these nuts passes a little gold screw, having a head fitted to a watch-key. The main point to hold in view in constructing this clamp portion is to insure a close bearing at the gum border, to prevent it from slipping off the teeth. The lock portion, for preventing the overlapping of the crowns when the force is continued after the teeth have been brought in contact, is a simple device, easiest made by bending a small piece of plate about one-quarter of an inch square, or a little larger, trough-

FIG. 185.

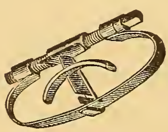
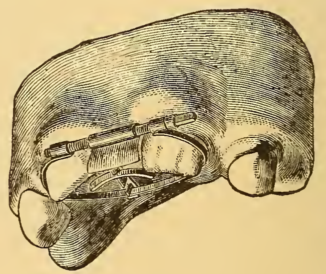


FIG. 186.



like, so as to fit the edges of the teeth; to this is soldered at right angles another piece of plate extending far up between the teeth nearly to the gum; on the upper end of this is soldered, transversely, about one-eighth of an inch of small tubing (smooth bore), through which passes the bolt of the clamp band and from which it is loosely suspended. This part (the trough portion) may be constructed skeleton-like, as shown by Fig. 185, and is more easily kept clean. The clamp is first applied, the force being intermittingly applied two or more times a day, or every time the band loosens by the movement of the teeth; but this should never be powerful enough to cause pain. After the teeth are brought in contact, or nearly so, the trough portion is added, and the force of the clamp band continued until the roots are brought into the desired position.

COMPULSORY ERUPTION OF THE TEETH.

The Matteson Method.

Occasionally a single impacted tooth in the jaw does not work its way down sufficiently to occlude with its opposite tooth, or the incisors do not meet when the jaws are closed. Such teeth are to be treated so as to make them as nature intended. Dr. A. E. Matteson, of Chicago, has been successful in using the following methods: A rubber plate was made to cover the roof of the mouth and to fit the necks of the teeth closely, a French clock spring being adjusted with one end riveted into the central posterior part of the plate (Fig. 187); when the spring was inserted and forced up against the plate, the distal end of the spring touched the necks of the teeth to be drawn out; ligatures were then fastened to the

Fig. 187.

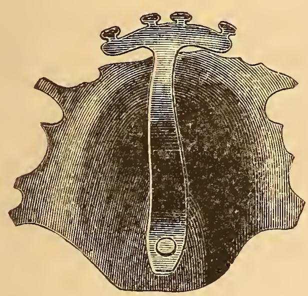
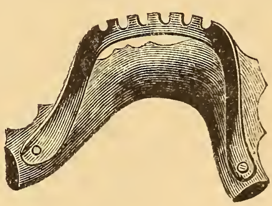


Fig. 188.



necks of the teeth, and the spring carried up to the plate and fastened to the teeth. If the spring be sufficiently powerful, from two to four teeth may be operated upon at one time.

The spring being movable upon the rivet in the plate, one tooth at a time can be erupted, and then the point of the spring may be turned to the next tooth.

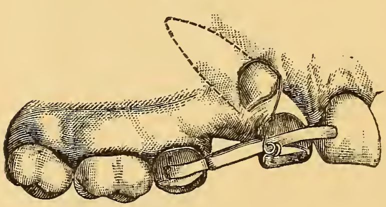
Fig. 188 shows a similar appliance for erupting the teeth on the lower jaw. Erupting teeth is unlike any of the other regulating operations, as no pressure to produce absorption is required.

When the lateral pressure has been removed, the mildest force is sufficient to draw a tooth out of the process, as the roots are conical and the pressure is directed away from the process instead of against it.

The Author's Method.

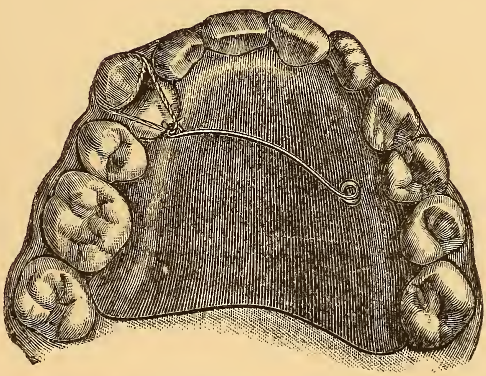
The author has been successful in erupting teeth by the following method: Fig. 189 illustrates the right superior lateral arch of a boy eighteen years of age. He has been a patient of mine from the first. At about the tenth year I was able to indicate in outline the crown and root of the cuspid, and noticed the marked obliquity of its position. The posterior column was crowding the bicuspids forward so that they eventually filled the space allotted to the cuspid. The teeth in the left superior lateral arch came into position in the natural order, and that arch was nearly normal. In the treatment of this case I waited until the point of the cuspid made its appearance, when I extracted the first bicuspid. Platinum bands were fitted to the second bicuspid and lateral incisor, and these were connected with a bar of platinum extending to and impinging upon the central incisor. A flat tube was then soldered to the bar for the purpose of securing a coiled spring, made of the smallest size piano-wire, the arms being cut to about the same length. One arm was doubled upon itself and so adjusted that when it was passed into the flat tube the suitably bent end of the other arm would reach forward and catch upon the point of the cuspid. By this means the cuspid was swung backward and pulled downward until the crown was in a direct line with the position it was to occupy when in place. An impression was then taken and a vulcanite plate made (Fig. 190), in which another spring of piano-wire was inserted in such a manner that when properly adjusted the end of the arm reached over and just inside of the space of the cuspid. A ligature was then tied around the neck of the tooth, and the arm of the spring drawn close to the crown and fastened. By glancing at Fig. 190 it will be observed that the action of the spring must be to draw the tooth not only down, but also inward to its position. In locating the spring in the plate, the position of the crown before and after it is brought into place must not be lost sight of. When the spring is applied for the purpose of drawing the tooth out of the alveolar pro-

Fig. 189.



cess, the patient must be seen every day, because in most cases this movement is so easily accomplished that only twenty-four hours are necessary to complete the operation. If, on the other hand, two or more days supervene before the patient is seen, the tooth would be erupted further than is required. I have observed such cases. Teeth wholly imbedded in the jaw may be erupted with a spring, as shown in Fig. 190, by first removing a piece of mucous membrane and alveolar process over the crown with Rollins' revolving knife. The advantages of this peculiar kind of spring in these difficult cases are—1st, it can be adjusted to any special angle required, and 2d, the force is constant and need not be readjusted for three or four days after it is applied (if the movement is not rapid), thus relieving the operator and patient from the expenditure of time in frequent office attendance.

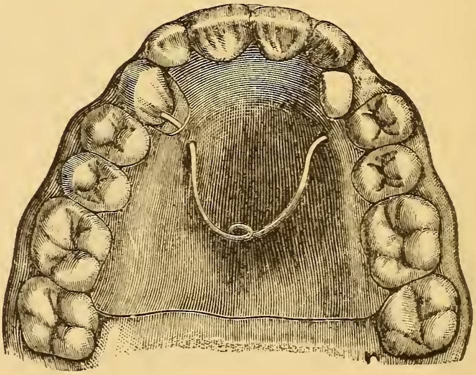
Fig. 190.



A form of irregularity of the teeth is occasionally observed wherein the cuspids erupt inside the arch. Sometimes the case presents when the point of the cusp has just penetrated the mucous membrane of the mouth, and again the tooth will have erupted its normal length. Frequently it will erupt in close contact with the lateral incisor and first bicuspid, or it may make its appearance in the roof of the mouth. Occasionally only one cuspid will be misplaced. Again, both cuspids will thus erupt out of position. The object of this article is to demonstrate a simple and easy method of correcting these very complicated cases. Fig. 191 illustrates an instance of the kind occurring in the mouth of a young lady sixteen years of age. Both cuspids were observed in process of eruption

inside the arches, and in contact with the adjoining tooth. The roots could be outlined on the outer alveolar plate as far as their apices, demonstrating the fact that the crypts containing the crowns were originally in normal positions, but that their crowns had subsequently pointed toward the roof of the mouth. A vulcanite plate was made, and a hole drilled through it so that the point of a wire spring would touch the cuspid just above the margin of the gum. On the opposite side of the plate a hole was drilled just deep enough to hold the other end of the spring when in position. A small hole was then drilled into the enamel (but not through it) just above the margin of the gum, to prevent the spring from slipping when adjusted in position. A strong spring was made of piano wire, No. 17 or 18 U. S. gauge, and the ends bent at right angles. One of the

Fig. 191.

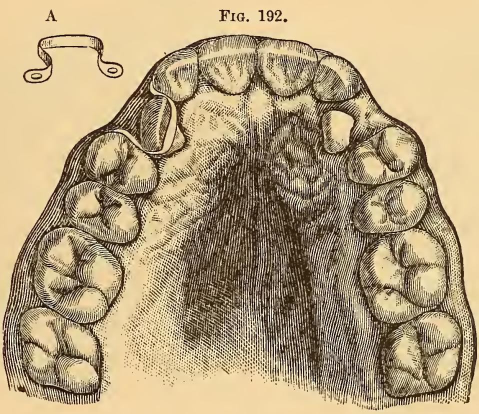


ends was cut short to fit into the hole made in the plate opposite the tooth to be moved, the other end left long enough to pass through the plate and sharp-pointed to enter a hole in the tooth to be moved. This very small hole was drilled in the enamel of the tooth, for the sharp point of the spring to rest in. In many cases such a spring will keep the plate in position, but should the plate slip it may be fastened to the bicuspid with ligatures.

Fig. 192 shows the same irregularity with a different appliance for bringing the tooth into place. This appliance is not my own idea, but I have been so successful with it for the past seven years that I deem it of value to the profession. It is made of German silver, which possesses all the requisite qualities. I have three thicknesses

of it ready for use, Nos. 29, 31 and 32, U. S. gauge. Strips are cut $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in width, according to the strength required, and bent with small round-nosed pliers into the shape represented at A, to fit the teeth (Fig. 192). This is removed every day, and with round-nosed pliers the ends are bent, the spring shortened, and forced to place upon the tooth. This little spring acts in two directions: 1st, to carry the teeth laterally and thus provide room, and 2d, to draw the irregular tooth into position. This appliance can only be used when the crown of the irregular tooth is fully erupted. Teeth situated outside the arch may be thus brought into line as well as those which are situated inside. In the latter case it is necessary to wear a plate to keep the jaws apart while the tooth is in transit.

Fig. 192.



Occasionally, by reason of their tardy eruption, the second bicuspids, and also, but much less frequently, the second molars, become locked in between the adjoining teeth, and are thereby suppressed. When this has occurred, the grinding surfaces usually are visible on a level with the gums, and, of course, operative occlusion with the teeth which should properly antagonize the suppressed teeth is impossible.

Fig. 193 is an illustration of the left side of the lower denture of a boy thirteen years old, and shows so much of the denture as is requisite for the purposes of this brief article. The second deciduous molar had been retained in the jaw beyond the natural period, and its mesial and distal surfaces had been so destroyed by caries

that the first permanent molar had come forward and greatly diminished its normal distance from the first bicuspid. The removal of the deciduous molar left an insufficient space for the accommodation of the coming second bicuspid, which consequently became locked between the molar and first bicuspid, so that complete eruption was impossible.

A narrow vulcanite plate was made, and a coiled wire spring made and applied as shown in Fig. 193 to force the teeth apart. When sufficient room had been gained, a cavity was formed in the crown of the second bicuspid, and a small wire eye-bolt set in the

Fig. 193.

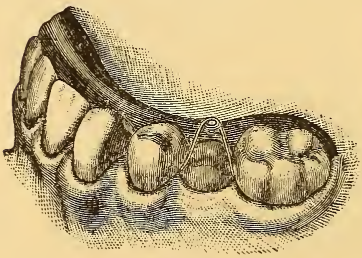
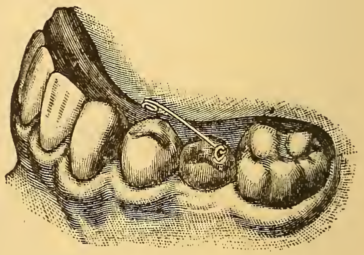


Fig. 194.



cavity with amalgam. Another coiled wire spring was fixed in the plate, and the spring lever inserted in the eye of the bolt, as shown in Fig. 194. The lifting action of the spring soon compelled the eruption of the bicuspid into its proper position and relations with the occluding teeth.

The removal of the eye-bolt, after cutting away the amalgam with a small round bur, and the subsequent filling of the small cavity with gold, completed the operation.

Obviously a ligature could have been forced down upon the submerged crown of the bicuspid, and the loop-hitch of the ligature be made a substitute for the eye-bolt; but this was preferred as a more positive means of attachment to the lifting spring lever.

CHAPTER VI.

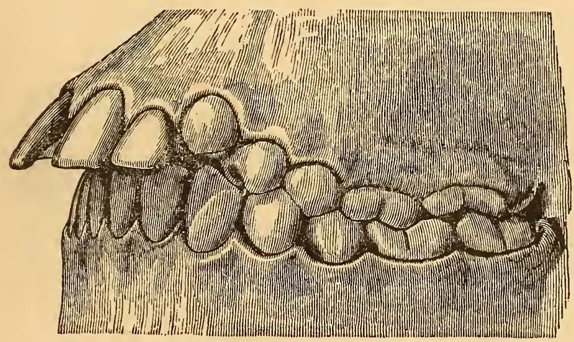
PROTRUDING TEETH.

KINGSLEY'S CASE.

The following case, with the accompanying illustrations, is reported by Dr. Kingsley:

Fig. 195 shows the condition of the teeth of a child of nine years of age, for which no adequate cause could be given, as it was not hereditary nor the result of thumb-sucking. Treatment was not

Fig. 195.



begun until the patient was thirteen years of age, when the permanent teeth had all made their appearance; and so much did the front teeth protrude, that it was with difficulty that the lips could be brought together, the incisors being spread or straggled, and the crowns of extraordinary length.

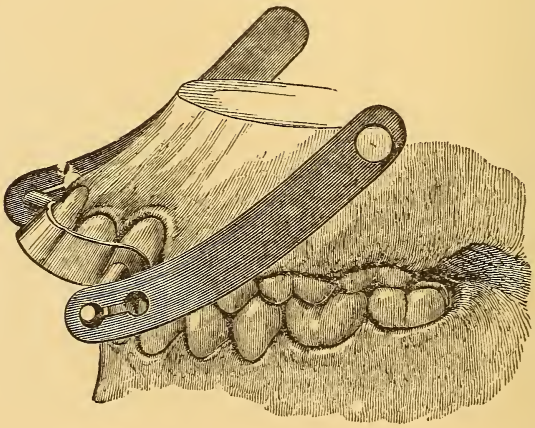
"A frame of gold was made, covering the cutting-edges of the incisors and lapping on the cuspids, and a plate of vulcanite adapted to the roof of the mouth, and cut away in front to provide for the retrocession of the teeth.

"Ligatures cut from rubber tubing were attached to the posterior part of the vulcanite plate, one on each side, and drawn forward and caught on projecting spurs of the gold frame.

"In a short time the arch in front was contracted until the teeth

were in contact, but it was not sufficiently reduced. More room being essential, the first bicuspid on each side was removed. The incisors had appeared to lengthen during the process (although, probably, they had not actually done so), and it seemed that they would eventually come down so as to touch the gum of the lower jaw. The attempt was therefore made to shorten the crowns by driving them up into the jaw. The former appliance was contin-ued, and to the gold frame was added a stud or post about one-half an inch long, soldered to it opposite the cuspids, and coming out at each corner of the mouth." This apparatus is shown in Fig. 196.

Fig. 196.



The arms, extending upward, passing outside the cheeks, were made of strips of brass and connected by elastic ligatures, with a leather skull cap, as shown in Fig. 197.

The vulcanite plate was inserted in the mouth, and the rubber ligatures brought forward and caught; the skull cap was then placed on the head, and strong elastic straps were caught over buttons or hooks on the cap, and like buttons or hooks on the cheek-arms, as shown in Fig. 197. The outside pressure thus forced the teeth up into the jaw, and the inside pressure drew them backward in a direct line. The apparatus did not interfere with the comfort of the patient, and was worn for three months constantly, and part of the time for two months more, at which time the six front teeth were carried backward so that the cuspids came in contact with

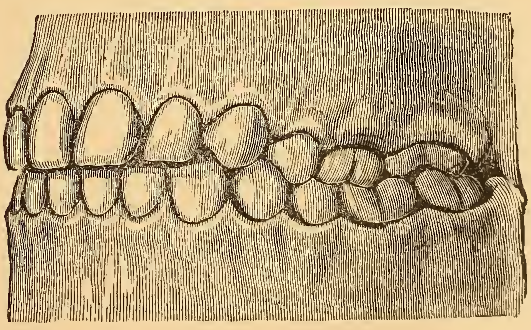
the second bicuspids, and the incisors were driven up into their sockets one-quarter the length of their crowns, with the result shown in Fig. 198.

Fig. 197.

FARRAR'S CASES.

When the abnormal protrusion of the six upper front teeth is very marked, the correction of the irregularity may require a greater degree of anchorage than is offered by the posterior teeth. Dr.

Fig. 198.



Farrar has devised an apparatus to meet such cases, known as a "bridle apparatus," which is illustrated in Fig. 199.

This is constructed as follows: "A gold strap of rolled wire,

having a smooth nut on each end, is bent to conform to the anterior surface of the four or six front teeth, and so fastened by means of screws to clamp bands on the posterior teeth, as shown in Fig. 201.

"To prevent this band from slipping up toward the gum, troughs have been tried, but they collect food and injure the teeth. I use one or more T pieces made to fit between the teeth, soldered to the band, or to ferrules sliding on the band (Figs. 201 and 204), or to broad plate hooks (Fig. 205).

"Another plan of attaining this end is by the use of a round wire resting upon the lingual surfaces of the teeth, connected in the

FIG. 199.

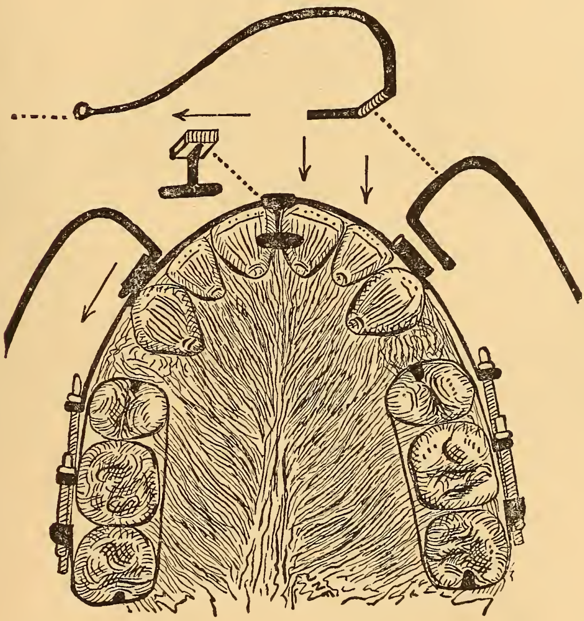
same way to the front band. The nearer these front wires approach the cutting-edges of the teeth, the less power it requires to move the teeth.

"The front band is connected with the outside apparatus by means of cylindrical or angular ferrules, or staples soldered to it at points opposite the spaces between the laterals and cuspids. Through these ferrules or staples, which are at a sufficient distance from the corners of the mouth to prevent the dribbling of saliva, are hooked bent cheek-wires, gold (about No. 12 gauge), that project forward and outward, thence pointing toward the ears on a line with the front band (Fig. 199). To prevent the falling over of this curved cheek-wire, one side of the ferrule portion may be filed

flat, and the ferrule shaped to correspond by a blow from a hammer; but this is seldom necessary.

"In some cases, in which detachment of the two parts is of no consideration, the cheek-wires may be soldered directly to the front band-piece (the retaining portion of the inside apparatus being dispensed with, Fig. 202, or double band, as shown in Fig. 203.) The outer extremities of these cheek-wires are screw-cut for drag nuts, one modification of which is illustrated by *B*, 203.

Fig. 201.

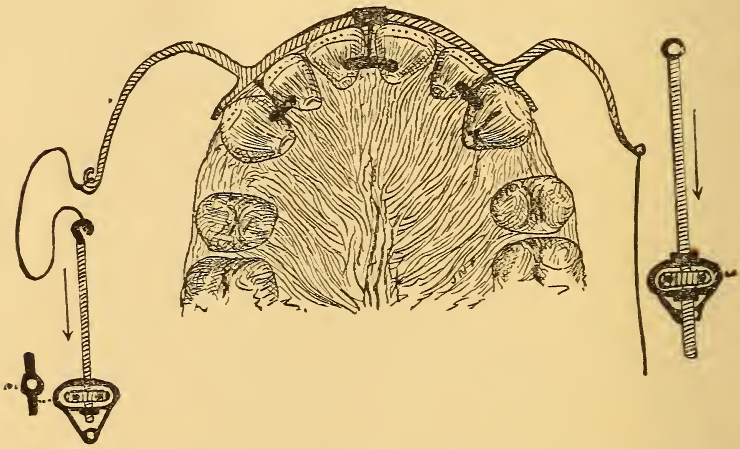


"These wires may be in two or more pieces, but as this causes a pressure upon the cheek, which may crowd upon the anchor apparatus inside of the mouth, it is much better to make the cheek-wire in one piece, which, if bent properly, will arch from the cheek to the ear-ring, without being in contact with the cheek.

"In fact, my experience teaches me that the latter is much the better form. The screw extends through the holes in opposite sides of a small ring, which is caught on one of several hooks soldered to a much larger ring extending around the ear of the

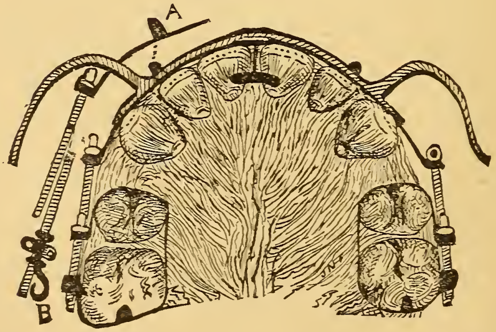
patient (Fig. 199). This larger ring (which is necessary to prevent interference with the ear) is fastened to inelastic straps extending around the back of the head and held in place by other straps, as shown. The lower straps and ear-rings constitute the anchorage apparatus. The ear-rings should be about two and a

Fig. 202.



half by three inches in diameter, underlaid by soft leather or felt rings about one-quarter to one-half inch wide, to serve as cushions to protect the skin. In order to have these rings rest

Fig. 203.



in their proper places around the ears, and to permit the harness to bear equally, so as to prevent headache, the several straps should be made capable of being tightened or loosened at will by means of buckles.

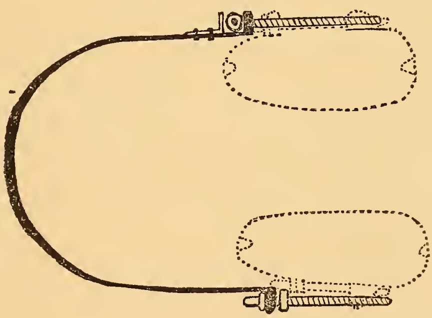
"When the apparatus is in position, the friends of the patients are instructed to tighten the posterior bands or to turn the nuts within the smaller rings daily. The patient is advised to call at the office once or twice a week, when, if the position of the teeth has changed sufficiently to render the front bands liable to slip off, the direction of the traction should be changed by raising the nut ring from a lower hook on the ear-ring to one higher."

Fig. 204.

Fig. 205.

Fig. 206 illustrates a device for the same purpose, exhibited to the profession by Dr. Farrar in Nov., 1885. This appliance consists of bands of gold or platinum, extending around the molars and bicuspids upon either side of the arch. A nut is soldered upon the buccal surfaces for carrying a long screw. A band of gold encircles the arch, and is secured by hooks midway between the cutting-

Fig. 206.



edges and necks of the incisor teeth. The ends of the band are bent at right angles, having holes through the ends for the free movement of the screws. The bands and teeth enclosed are the fixed points, and by turning the screws twice a day the anterior teeth are carried to the posterior part of the alveolus. This appliance claims cleanliness and the advantage of being out of sight as its strong points for its recommendation to our use.

TREATMENT OF ANTERIOR PROTRUSIONS OF THE SUPERIOR DENTAL ARCH.

The Author's Method.

The etiology of this class of cases is given on page 159. A typical case is here described with sufficient minuteness to be of use to those who have never attempted the correction of such, presenting points of interest even to one who has had considerable experience in regulating.

M. C., a boy fifteen years of age, presented the following conditions: The lower incisors struck against the palate, back of the basilar ridge, and the first bicuspids of the upper jaw stood entirely outside of the lower ones. The articulation of the second bicuspids and lower molars was imperfect. In consequence of the irritation that preceded the protrusion the upper alveolar process was monstrously developed. This display of gums and teeth, exaggerated by a very short upper lip, disfigured the boy, who otherwise had an interesting and agreeable face.

A rubber plate was placed in the mouth, fitting the vault, and of sufficient thickness in front to separate the posterior teeth, in order to lengthen them, and to force the lower incisors into the jaw. This was renewed once or twice to give additional space. When this process was completed so as to leave a space of three-sixteenths of an inch between the vault and the lower incisors, a spring plate was inserted in the lower jaw, extending as far back as the shortest diameter of the lower arch. When first introduced it was left without the spring to accustom the wearer to the annoyance. Then holes were bored opposite the lower first bicuspid, and short pegs inserted, which by absorption of moisture spread these teeth. These were removed and lengthened slightly. Then the spring was put in. In this case a plate in the vault to which the first upper bicuspids were attached by means of ligatures aided in bringing them in. Sufficient time was allowed for these steps, so as not to exhaust the patient too much. When the strain proved too great he was taken out of school and allowed to be in the open air as much as possible. About three months elapsed before these steps were completed and an attempt was made to bring in the incisors. The centrals were first acted upon alone, as the excessive proliferation of bone-cells in the process and the maxillary bone in each case

affords great resistance, and it is difficult to make an apparatus to meet this difficulty. To attach the front teeth to the back teeth by means of elastic or metal bands often results in embarrassment, as these will loosen while the front teeth remain firm. A number of ingenious apparatuses have been devised by professional gentlemen of reputation, combining sliding metal bands and elastic bands attached to posterior teeth. These work in some cases, but in those in which great resistance is offered they have proved a failure in the experience of the author, moving the molars or bicuspids forward instead of the front teeth backward. Such cases have occurred in the author's practice a number of times. It is best, therefore, to loosen one or two at a time. Sometimes the first steps can be taken most advantageously by simply inserting rubber ring wedges between the incisors, making them more easily acted upon. In this case ligatures were attached to the two central incisors, and these attached to a plate covering the vault, but not near the anterior margin but to the centre, for the purpose of distributing force. The ligatures were then changed to a band extending over the central incisors, to which hooks were attached.

This apparatus is of limited efficiency, as the force of the band is spent in part in the anterior margin of the plate over which it passes. The central incisors having been moved, to some extent, it was thought desirable to bring in the laterals as well, by means of an appliance exerting greater force. A cap of linen and tape was made, buckling tightly at the back of the head. Three strips of tape converged back of the ear. To these and the linen band passing around the head, rings of piano-wire covered with zephyr were sewed. In front of these rings loops of wire had been previously soldered for the attachment of elastic bands and ligatures. It is not desirable to make the cap of elastic bands because the rubber, when worn for some time, irritates the scalp, and there is a tendency to slip up and down. In making the appliance the slope of the head must be taken into consideration, for which reason care must be exercised in filling. The appliance was inserted into the mouth, to which the rubber bands were attached by ordinary ligatures. The length of the arms (Dr. Goddard's appliance) decidedly increased the elasticity and efficiency of the apparatus.

The patient came to the office twice a day to have the case inspected and such changes made in the adaptation of the appliance

as seemed necessary. Such changes are by no means infrequent, as the pressure will be unequal, no matter what care is exercised, for which reason there will be more or less soreness in spots. The tightening of the ligatures produces a similar result. Careful watching in such cases is necessary, and there must be an occasional day of rest, during which a retaining appliance should be worn.

After three months, making six months in all, the patient's upper jaw was nearly normal, and he was dismissed.

PROTRUSION OF THE INFERIOR MAXILLA.

ALLAN'S CASE.

Fig. 207 represents a case of protrusion of the inferior maxillary treated by Dr. George S. Allan, of New York.

The irregularity pertaining solely to the jaw, that alone was operated upon. A brass plate was made to fit the chin, having arms with hooked ends arranged so that the distance between them could be altered by pressing them apart or together. A network was adjusted upon the head, having two hooks on each side, one above and the other below the ear, to which were attached four ligatures of ordinary elastic rubber. The operation proceeded rapidly, and at the end of two months the irregularity was almost entirely cured. In this operation the result was attained by pushing back the condyles of the jaw into the glenoid cavity, the interarticular cartilage giving way and absorption taking place posterior to the condyles, with a filling in at the anterior side.

METHODS OF RETENTION OF THE TEETH AFTER REGULATING.

No element of regulating the teeth is more difficult than that of securing the teeth firmly after they have been forced into their new positions. The inclination to return to their original places is increased when the teeth are moved faster than the physiological process of filling in new material is accomplished. Pressure of the lips and tongue exerts influence in producing backward and lateral pressure upon the teeth. The greatest help in this direction is to so plan the operation, either by extraction or by inward or outward pressure (as the case requires), that when completed the posterior teeth will occlude in such a manner that they will hold one another in proper positions. Dr. Kingsley, in his "Oral Deformities," says:

"The articulation of masticating organs is of much more importance than their number, and a limited number of grinding teeth fitting closely on occlusion will be of far greater benefit to the individual than a mouthful of teeth with the articulation disturbed."*

Fig. 207.

Occlusion, however, will not retain the anterior teeth in position. Nor will it be safe to depend entirely upon occlusion to hold the posterior teeth in position. In most cases other means must be devised for holding the anterior teeth in position. Cases of this kind are apt to be those in which the arch of the superior or the inferior maxilla has been spread or the anterior teeth have been moved inward or outward. It is then frequently necessary to spread both arches by simply carrying the teeth of one jaw out to the proper distance and securing them with a retention plate; the teeth of the opposite jaw will, in most cases, be forced into their positions by their grinding surfaces coming in contact in mastication. Fig. 208 shows one of these retention plates: It fits the roof of the mouth and teeth accurately, and can be readily removed for cleansing.

* *Op. cit.*, p. 43.

Such a plate is of service upon either jaw for preventing one or all the teeth from rotating back toward the inner part of the mouth.

FIG. 208.

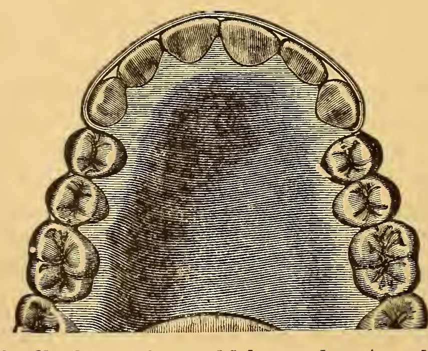
KINGSLEY'S RETAINER.

For holding the anterior teeth in position, the appliance recommended by Dr. Kingsley answers the purpose admirably. It consists of a rubber plate fitting the teeth and the roof of the mouth, and having a band of platinum or gold secured to it. The band passes through a separation in the teeth upon either side, and impinges upon the labial surfaces of the anterior teeth, as represented in Fig. 209. This application will not serve when the teeth are crowded.

RICHARDSON'S RETAINERS.

Where all the teeth in the jaw have been moved, particularly if some have been rotated into position, a retentive plate that comes

FIG. 209.



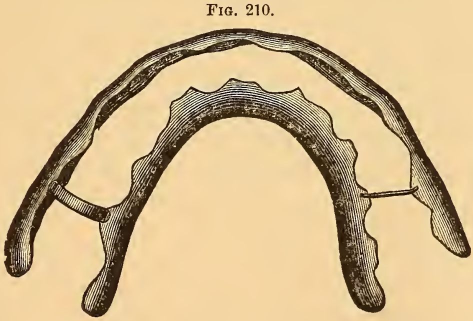
in contact with all the teeth should be used. A rubber plate will fit each tooth accurately without trouble or expense. Dr. Richard-

son gave his retentive plate to the profession many years ago, and in many respects it cannot be improved upon. Fig. 210 illustrates this appliance. It is composed of two pieces of rubber, vulcanized upon the labial and lingual surfaces of the teeth of the plaster model. These are trimmed to about a quarter of an inch in width, and fitted to the necks of the teeth and gums. When a tooth is missing upon either side of the jaw, or when spaces exist between the teeth, or there is room behind the molars, the rubber may extend from the outer to the inner plate, and thus the two pieces be made into one. If, as in the illustration, there be little or no room to carry the rubber from one piece to the other, flattened or round gold wire may be vulcanized or riveted so as to hold the wire in position. The only objection to this appliance is its unsightly appearance. It can, however, be removed by the patient for cleansing.

RUBBER PLATES WITH GOLD BANDS AND BARS.

When single teeth have been rotated in their sockets, or moved in or out for the purpose of perfecting the contour, a simple arrangement for retaining the teeth is to fit a rubber plate to the palatine or lingual surfaces of the teeth, and attach a bar or clasp of gold to the teeth that have been moved. Fig. 211 illustrates a

Fig. 210.

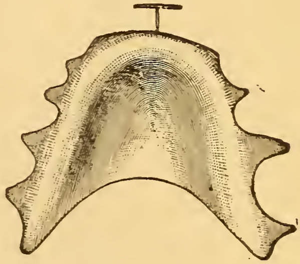


retaining plate with a bar attached for holding the superior central incisors in their position after regulating. The bicuspids and molars may be treated similarly.

Rubber retainers are apt to be inconvenient for cleansing properly. Patients are inclined to be careless on this account, but should be instructed to attend to this duty after each meal, to pre-

vent the secretions from becoming vitiated, the gums inflamed and the teeth decayed. Great improvements in these appliances have been made in the past few years, as will be observed on examining some of the methods below.

Fig. 211.



FARRAR'S RETAINERS.

Dr. Farrar, of New York, has invented some ingenious appliances for holding teeth in proper positions; among these are his clamp bands. Some are composed of one piece of gold, others of two pieces. Fig. 212 represents one form made from square, 18-carat gold wire. This will take a size to correspond with the tooth and the amount of resistance required to hold it in place. A thread is cut from one end to about a third of its length; the remainder of the wire is rolled or hammered into a thin band, about No. 35 or 36 American gauge, and about one twenty-fourth of an inch in breadth. At the distal end a hole is drilled, large enough to allow the screw end to pass through with a thread cut upon it. Small projections should be soldered upon the band and bent so as to catch upon the tooth. When two pieces of gold are used,

Fig. 212.

Fig. 213.

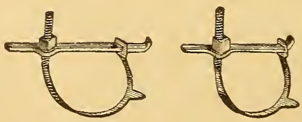
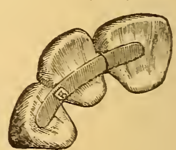


Fig. 214.



the band is made in the manner described in the first case, and bars of the same carat gold rolled to Nos. 22 and 23, American gauge. One end of the bar is bent to an angle of forty-five degrees to pre-

vent the band from slipping. Near the other end of the bar a hole is drilled for the passage of the screw end of Fig. 213.

By adding rings to either kind of bands they may be used for anchor bands. Fig. 214 shows how they are used as a retaining band while in position.

DR. GUILFORD'S RETAINER

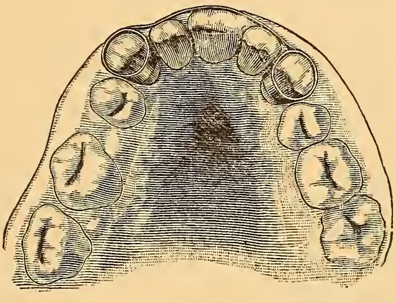
Dr. Guilford's retainer consists of a band of gold or platinum (Fig. 215) swaged or fitted accurately to the tooth and of sufficient strength to resist the rotary strain and friction in mastication. By

FIG. 215.

FIG. 216.

trimming the labial surfaces as narrow as compatible with strength, the band will not appear conspicuous. It should be adjusted midway between the cutting and grinding edges of the gum, and there cemented to the tooth with oxyphosphate of zinc. This can be

FIG 217.



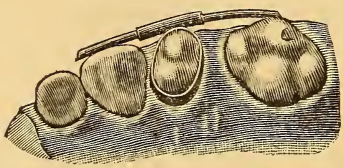
worn indefinitely without affecting the gums or teeth, and can be cleansed perfectly; hence the bands, bars or levers may be firmly soldered for rotating or retaining the teeth after regulating. Fig. 216 shows the application of two of these bands when two teeth are secured in position by a bar extending past fixed teeth on both sides. When two or more teeth are to be held in position, the bands may be secured to the bicuspids or molars on both sides, and a bar of gold extended from one to the other, upon the lingual or labial surface, as illustrated in Fig. 217, from Dr. Guilford's collection. "Platinum bands were fitted to the two cuspids, and these

were connected by a very thin platinum wire passing along and conforming to the outline of the labial surfaces of the incisors."

The Author's Retainer.

This retainer consists of a band of platinum or gold fitted to the tooth or teeth, with a tube of the same material, the width of the tooth, soldered lengthwise of the band, as illustrated in Fig. 218. The band is fastened to the tooth with oxyphosphate of zinc, and a piece of gold, platinum or piano-wire is passed through the tube and allowed to come in contact with the surface of a firm tooth. Should the tooth that has been regulated move, the wire may be bent so that the tooth may be restored to its proper position. Two or more teeth may be retained in the same manner. The tube may be attached to the labial, buccal, palatine or lingual side of the band, according to the requirements of the case.

Fig. 218.



Length of Time Required to Retain the Teeth in their Place.

Two reasons governing the time required to retain the plate upon the teeth are, first, the age of the patient; second, the nature of the operation. The time cannot be definitely stated for all persons, even of the same age and condition of case; an approximate period only can be fixed. In young and healthy persons, in whom reconstruction of tissue is rapid, the retainer will be needed but a comparatively short time. If the superior or inferior arches have been enlarged, a retaining plate must be worn until all the teeth have accommodated themselves to their new position—a period that will vary from six months to a year.

Where the teeth have been forced into the arch little or no retention will be required, the pressure of the lips and cheeks often being all that is necessary. Occlusion of the teeth of the opposite jaw aids greatly in retaining the bicuspids and molars.

The most difficult teeth to retain are those that have been rotated in their sockets. The difficulty of correcting the tendency to return to their original positions is so great that the retainers must be kept in place from one to two years, and occasionally even

longer than this. The operator will have to use his best judgment as to the proper time to remove them. The number of teeth being moved does not affect the time required, as the bone is as rapidly deposited in one part of the jaw as another. The health of the patient will have considerable influence in the time required. A strong, robust person will recover from the operation more rapidly than one that is anæmic. The retainer should remain as long as circumstances will warrant, when a model should be secured. After the lapse of not longer than a day, an examination should be made. If the teeth have not deviated, a week may elapse before making another examination. These examinations should be continued until the operator is satisfied that the teeth are secure. If the teeth should move, the retainer must be replaced, and allowed to remain for from three to six months, when it can be removed, and if any deviation is noted, it should be returned and worn until the teeth will remain as desired.

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